JOURNAL OF DAIRY SCIENCE

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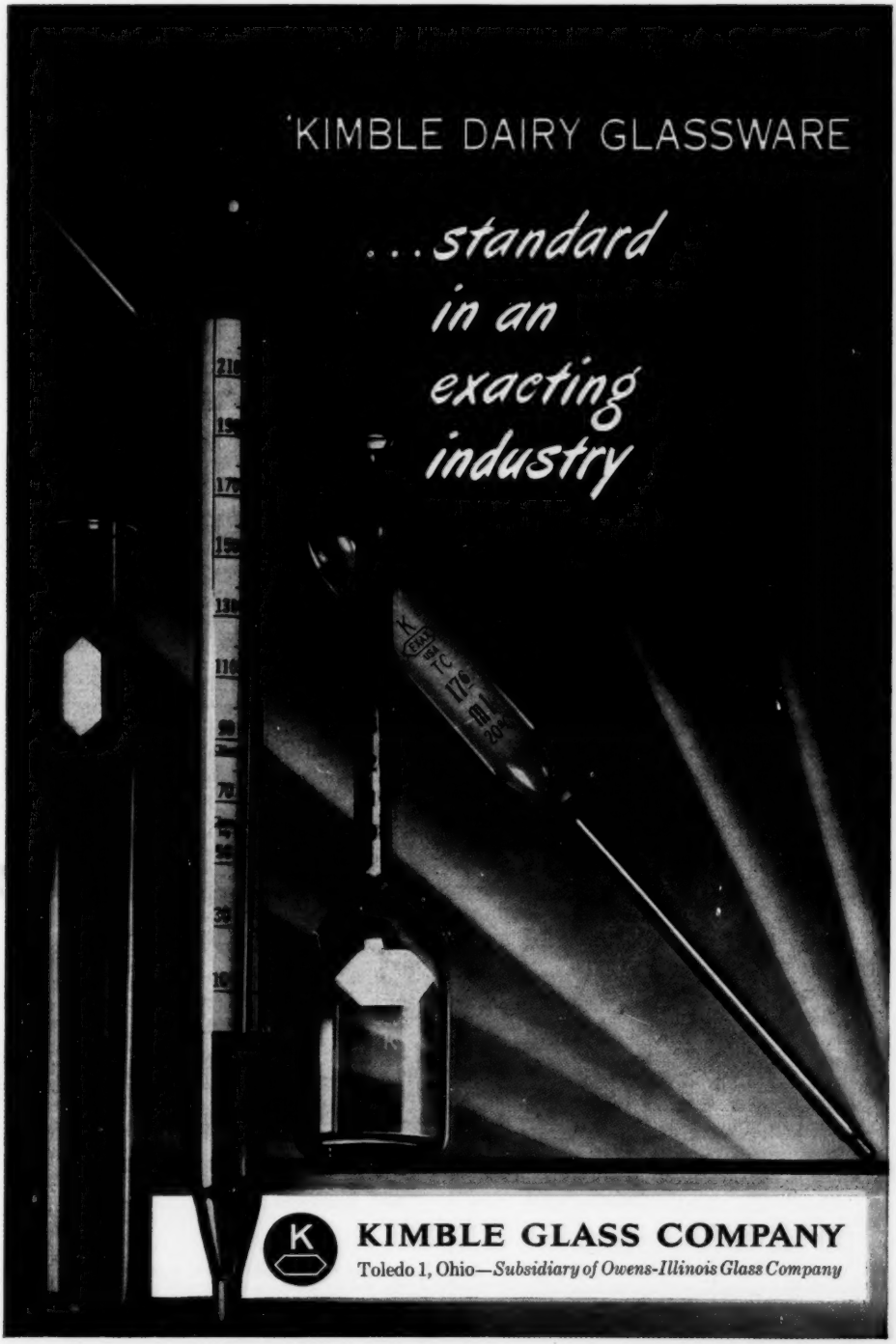

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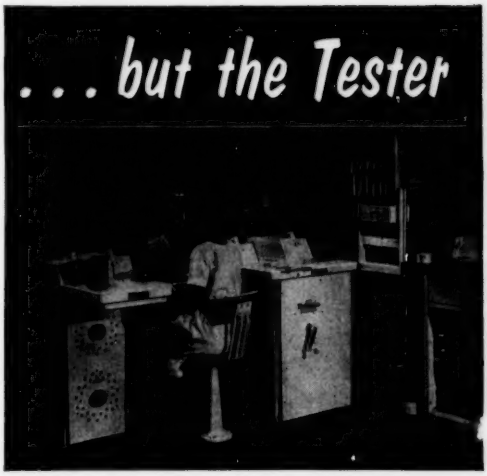

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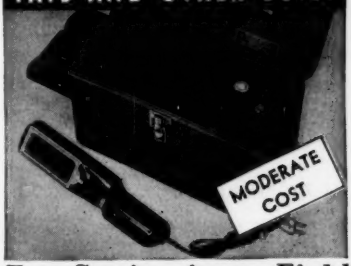

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JOURNAL OF DAIRY SCIENCE

VOLUME XXXVI AUGUST, 1953 NUMBER 8

COMPARISON OF METHODS FOR THE ESTIMATION OF VITAMIN A IN CALF PLASMA [1]

J. E. AVAMPATO AND H. D. EATON
Animal Industries Department,
University of Connecticut, Storrs

Currently the methods most used in the determination of vitamin A in bovine blood employ the Carr-Price reaction (9). The most widely used of these methods is that of Kimble (14), which appears to be satisfactory for blood containing less than 350 γ per cent of carotenoids (17).

Sobel *et al.* (20) have introduced a method using glycerol dichlorohydrin (GDH) as a color reagent. GDH has the advantage over antimony trichloride that it is not corrosive and the violet color produced is more stable than the blue color produced with antimony trichloride (6). However, the violet color is less intense, and different batches of GDH vary in sensitivity with age and method of activation (1, 2).

Both colorimetric methods have the disadvantage that their respective reactions are not specific for vitamin A. For example, β-carotene and other carotenoids also produce colors with antimony trichloride and GDH. There are other unidentified substances which interfere either by forming the color or inhibiting its formation. Saponification is believed to remove some of these substances (3, 10, 16, 17, 21).

A third method often used in determining vitamin A (mostly in fish oils) is based on the spectrophotometric absorption of the vitamin at or near 328 mμ. Here again the method is not specific, other substances interfering by absorbing in this region of the ultraviolet.

Since there is no method which is specific for vitamin A, it becomes necessary to isolate it. Boyer *et al.* (7) have devised a method in which carotene is separated from vitamin A by precipitation from a 50- to 60-per cent ethyl alcohol solution. Alumina has been used for chromatographic separation of blood vitamin A and carotene (16, 23, 24).

The purpose of this study was to compare the antimony trichloride, the glycerol dichlorohydrin, and the ultraviolet absorption methods of determining vitamin A in bovine calf plasma containing low and higher amounts of carote-

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[1] These data are part of a thesis submitted to the Graduate School of the University of Connecticut by the senior author in partial fulfillment for the M.S. degree. The study was supported in part from funds provided under the Research and Marketing Act of 1946, also in part by the Chas. M. Cox Co., Boston, Mass. and the Big-Y Foundation, Norwich, Conn.

noids; and to determine the effect of saponification and the effect of separating vitamin A from carotenoids by precipitation and by chromatography.

EXPERIMENTAL

Calves. The calves used for low carotenoid blood consisted of four Holsteins and one Ayrshire with an average age of 66 ± 17 days and an average weight of 189 ± 26 lb. They were fed up to 4 lb. daily of a standard starter used at this station (12), containing in addition 30 lb. of an aureomycin supplement (Lederle's Aurofac) per ton of mixture. They were fed hay *ad libitum;* the average grade was U. S. No. 1.6 green mixed hay, chopped at a setting of ¼ in.

High carotenoid blood was obtained from one Holstein, two Guernseys, and two Ayrshire calves with an average age of 198 ± 5 days and an average weight of 339 ± 15 lb. They were each fed 4 lb. per day of the standard starter, limited amounts of chopped artificially-dehydrated alfalfa and mixed grass-clover hay *ad libitum.*

Samples and analyses. To allow for sufficient plasma, 180 ml. of blood was obtained by jugular puncture from each calf in either the "low" carotenoid or "high" carotenoid group. This blood was citrated, pooled into a single sample, and chilled at 4° C. for ½ hour. The plasma then was aspirated off into a common container, and 10-ml. aliquots were pipetted into 50-ml. glass-stoppered centrifuge tubes and frozen at −15° C. Each of these samples then was subjected to one of 18 treatments in three factor-randomized block designs (8), as described in Table 1. Calves in each particular carotenoid grouping were re-bled five additional times to allow six replications of the design.

Since it was not feasible to complete all 18 treatments in one day, the following combinations of treatments were run on different days: no separation (treatments 1, 2, 7, 8, 13 and 14), separation by precipitation (treatments 3, 4, 9, 10, 15 and 16), and separation of carotene by chromatography (treatments 5, 6, 11, 12, 17 and 18). To control the order in which these treatments were performed, the first replicate was randomized and the second and third were restricted to form a 3 × 3 Latin square in which the rows were the days, the columns the replicates, and the treatments the combinations indicated above. This procedure was repeated for the fourth, fifth, and sixth replicates.

Extraction. Each day 12 samples (six in duplicate) were removed from storage, and the carotene and vitamin A were extracted according to Kimble (14) except that 10 ml. of plasma and 15 ml. of petroleum ether (Merck, Benzin B. P. 30-60° C.) were used. The petroleum ether extract will be referred to henceforth as Kimble extract. Instead of being centrifuged, the samples were placed in the refrigerator for ½ hour after shaking. Ten ml. aliquots of the Kimble extract of each sample were taken, of which six were saponified and six were not.

Saponification. The Kimble extracts of the samples which were to be saponified were evaporated to approximately 1 ml. in a 60° C. water bath and to dryness in a vacuum desiccator. To the residue was added 8.0 ml. of U.S.P. absolute

TABLE 1

METHODS

Antimony trichloride ($SbCl_3$)	Glycerol dichlorohydrin (GDH)	Ultraviolet absorption (Beckman)
(1) — Saponification, — separation	(7) — Saponification, — separation	(13) — Saponification, — separation
(2) + Saponification, — separation	(8) + Saponification, — separation	(14) + Saponification, — separation
(3) — Saponification, + separation by precipitation of carotene	(9) — Saponification, + separation by precipitation of carotene	(15) — Saponification, + separation by precipitation of carotene
(4) + Saponification, + separation by precipitation of carotene	(10) + Saponification, + separation by precipitation of carotene	(16) + Saponification, + separation by precipitation of carotene
(5) — Saponification, + separation of carotene by chromatography	(11) — Saponification, + separation of carotene by chromatography	(17) — Saponification, + separation of carotene by chromatography
(6) + Saponification, + separation of carotene by chromatography	(12) + Saponification, + separation of carotene by chromatography	(18) + Saponification, + separation of carotene by chromatography

ethyl alcohol, aldehyde-free (4), and 2.0 ml. of 25-per cent aqueous potassium hydroxide. The concentrations of alcohol and potassium hydroxide, as well as the temperature used, were based on preliminary studies of saponification.[2] The mixture was heated at 70° C. for 20 minutes, and the unsaponifiable fraction was extracted by the method of Boyer *et al.* (7) except that the first extraction was made with 10 ml. of diethyl ether (Merck, U.S.P. for anesthesia) instead of 5 ml. and the water washings were not reextracted with ether. It was found that the latter procedure reintroduced artifacts which had been removed by washing.

Based on preliminary studies,[3] the stopcock lubricant used in these studies was "Non-Aq" (Fisher Scientific Co.). Blanks consisting of 10 ml. petroleum ether treated like the petroleum ether extracts of blood plasma were run for saponified samples analyzed by the ultraviolet absorption and GDH methods, but none for the antimony trichloride. Unfortunately it was not anticipated that blanks should be run for the two separation methods for nonsaponified samples. That they should have been run is evident from the extremely high values for vitamin A at 325 mμ on the Beckman.

Separation of carotene and vitamin A. Carotene and vitamin A were separated by the methods described by Boyer *et al.* (7) and Thompson *et al.* (23). The following changes were made in the Boyer *et al.* method: one-half per cent instead of 0.05 per cent sodium chloride was used to prevent the formation of a colloidal suspension; the vitamin A was extracted from the filtrate with 15 instead of 13 ml. of petroleum ether; the β-carotene correction was used to correct for xanthophylls. As much of the precipitated carotenoids as possible was recovered by washing petroleum ether through the filter paper until 15 ml. of washings were collected. In most cases some carotenoids adhered to the filter paper.

The following changes in the chromatographic separation as described by Thompson *et al.* (23) were made: instead of n-hexane, Skellysolve B (Skelly Oil Co. B.P. 60-71° C.) was used; activated alumina (Aluminum Company of America, Grade F-20) without further treatment was used instead of the steam-activated alumina used by Thompson.

After saponification and separation or no separation, two each of the saponified and nonsaponified samples were analyzed for vitamin A by the Kimble (14) method on the Evelyn photoelectric colorimeter, by the Sobel (20) method on the Coleman Model 14 spectrophotometer and by measuring the absorption at

[2] During preliminary studies of saponification, artifacts were found even after the ethyl alcohol had been made aldehyde free (4) as indicated by the Carr-Price reaction. Therefore, blank runs were made on all the possible combinations of 70, 80, and 90 per cent alcohol and 5, 10, and 15 per cent potassium hydroxide at 40 and 70° C. and at the temperature of boiling water (approximately 96° C.). The least amount of artifact was obtained when a temperature of 70° C. and 5 per cent potassium hydroxide in 80-per cent ethyl alcohol were used.

[3] The stopcock lubricant used in the preliminary studies of saponification was Lubriseal (Arthur H. Thomas Co.). However, it was later discovered that Lubriseal interfered with the ultraviolet absorption. When Dow Silicone "stopcock grease" was tried, it also caused interference. Both lubricants caused a flocculent suspension or precipitate when GDH was used. Then Non-Aq (Fisher Scientific Co.) was found to give considerably less interference in the ultraviolet, a little with GDH (no precipitate), and practically none with antimony trichloride.

325 mμ on the Beckman Model DU spectrophotometer. It was intended originally to use the Morton and Stubbs (15) correction method, but it was found not applicable in all cases.

Carotenoids were measured at 440 mμ on each instrument. When separations were made, both the carotene and vitamin A fractions were analyzed for both constituents.

Standard curves. Each instrument was calibrated at 440 mμ with β-carotene,[4] using three 10-mg. ampules to make up three sets of standard solutions ranging in concentration from 0.2 to 40 γ per 10 ml. Each set of standards was read three times on each instrument and a carotene correction was obtained each time. A similar procedure was used to calibrate each instrument with vitamin A alcohol.[5] Prediction equations were obtained by a regression of concentration on 2-log G by the method of least squares (11), G being the galvanometer reading corresponding to a given concentration.

Statistical treatment of data. The analysis of variance for either "low" carotenoid blood or "high" carotenoid blood included the three main effects, methods, saponification, and separation, as well as the first and second order interactions of these effects (8, 19). It was as follows:

Source of variation	*Degrees of freedom*
Saponification	1
Methods	2
Separation	2
Methods × saponification	2
Methods × separation	4
Saponification × separation	2
Methods × saponification × separation	4
Replicates	5
Error	85
Within duplicates	108
Total	215

In Tables 2 and 3 the values represent arithmetic means ± their standard errors.

RESULTS AND DISCUSSION

Plasma carotenoids. In general, Kimble extracts gave higher total carotenoids (Table 2) when read with the Coleman or Beckman instruments than with the Evelyn. This indicates that the extracted blood pigments differed chemically from the β-carotene standard used. Saponification resulted in lower total carotenoid values ($P < 0.001$) for both types of blood. In "low" carotenoid blood samples, not separated and read in the Evelyn and Coleman instruments, there were slight but not significant increases in carotenoids after saponification. This

[4] Crystalline β-carotene, General Biochemicals Inc., Chagrin Falls, Ohio.

[5] Crystalline vitamin A alcohol, General Biochemicals Inc., Chagrin Falls, Ohio.

TABLE 2

The effect of saponification and method of separation of carotene and vitamin A on the determination of carotenoids using three different instruments

	Evelyn		Coleman		Beckman	
	Saponification		Saponification		Saponification	
	(−)	(+)	(−)	(+)	(−)	(+)
	"Low" carotenoid plasma—carotenoids γ%[a]					
No separation	19.9 ± 2.0	22.5 ± 2.9	23.0 ± 2.3	28.8 ± 3.1	23.4 ± 1.9	18.9 ± 0.9
Precipitation of carotene						
Carotene fraction	11.0 ± 1.6	0.9 ± 0.5	15.0 ± 1.6	1.1 ± 0.5	16.1 ± 1.4	6.0 ± 0.2
Vitamin A fraction	−0.2 ± 0.4	4.9 ± 1.0	2.4 ± 0.4	5.0 ± 1.0	5.9 ± 0.5	9.0 ± 1.0
Total	10.8 ± 1.8	5.8 ± 1.3	17.4 ± 2.0	6.1 ± 1.4	22.0 ± 1.7	15.0 ± 1.0
Chromatography						
Carotene fraction	9.7 ± 1.1	8.1 ± 1.5	12.6 ± 1.0	7.7 ± 1.1	13.5 ± 1.0	10.4 ± 1.0
Vitamin A fraction	5.7 ± 1.1	5.1 ± 1.4	9.8 ± 1.3	6.6 ± 1.1	10.5 ± 0.9	8.2 ± 0.8
Total	15.4 ± 2.1	13.2 ± 2.3	22.4 ± 2.1	14.3 ± 2.2	24.0 ± 1.8	18.6 ± 1.7
	"High" carotenoid plasma—carotenoids γ%[a]					
No separation	161.4 ± 5.3	146.2 ± 3.1	168.0 ± 3.5	161.3 ± 4.6	167.2 ± 6.1	156.4 ± 4.8
Precipitation of carotene						
Carotene fraction	132.3 ± 2.6	63.8 ± 3.9	139.8 ± 4.1	66.8 ± 3.0	138.8 ± 3.8	69.8 ± 3.6
Vitamin A fraction	8.3 ± 1.3	34.4 ± 1.8	10.9 ± 0.2	36.7 ± 2.3	13.9 ± 1.1	36.1 ± 1.6
Total	140.6 ± 2.8	98.2 ± 4.8	150.7 ± 4.2	103.5 ± 4.3	152.7 ± 4.0	105.9 ± 4.7
Chromatography						
Carotene fraction	119.2 ± 2.4	108.7 ± 2.1	123.2 ± 2.2	113.0 ± 2.3	121.7 ± 1.5	117.4 ± 2.7
Vitamin A fraction	34.0 ± 2.2	30.5 ± 1.5	39.6 ± 2.9	29.1 ± 1.2	39.5 ± 2.0	30.9 ± 1.3
Total	153.2 ± 2.8	139.2 ± 2.3	162.8 ± 2.6	142.1 ± 2.3	161.2 ± 2.8	148.3 ± 3.2

[a] Arithmetic means for six replicates in duplicate ± their standard errors.

apparent increase is attributed to a slight cloudiness which occurred after saponification and was sufficient to overcome the actual decreases in carotenoids after saponification. For "high" carotenoid blood samples the absolute decrease in carotenoids after saponification was greater than for the "low" carotenoid blood. Therefore the cloudiness interfered less. This cloudiness was eliminated in the separation procedures.

For both types of blood, chromatographed samples had higher values than those separated by precipitation of carotene. That lower values were obtained by the Boyer method is not surprising since, as pointed out previously, the recovery of carotene from the filter paper was not complete. Nonseparated samples read higher ($P < 0.001$) in total carotenoids for both types of blood than those separated by either method of separation.

Precipitating carotene of nonsaponified samples was a more efficient method of separating vitamin A and carotene than chromatography on alumina, using the amount of yellow color in the vitamin A fraction as criterion. Table 2 shows the amount of carotenoids (means for six replicates) in the vitamin A fraction for all samples separated. After saponification, the efficiency of separation was

TABLE 3

The effect of saponification and method of separation of carotene and vitamin A on the determination of vitamin A

	SbCl₃		GDH		Beckman	
	Saponification		Saponification		Saponification	
	(—)	(+)	(—)	(+)	(—)	(+)
	"Low" carotenoid blood—vitamin A γ%[a]					
No separation	19.2 ± 0.3	17.7 ± 0.6	19.7 ± 0.7	16.0 ± 0.8	25.7 ± 1.0	31.4 ± 1.8
Precipitation of carotene						
Carotene fraction	3.2 ± 0.2	1.7 ± 0.2	2.6 ± 0.2	2.1 ± 0.3	16.4 ± 1.1	3.8 ± 1.4
Vitamin A fraction	15.1 ± 0.4	16.1 ± 0.3	13.2 ± 0.8	14.7 ± 0.5	26.2 ± 1.4	17.3 ± 1.2
Total	18.3 ± 0.3	17.8 ± 0.4	15.8 ± 0.7	16.8 ± 0.6	42.6 ± 2.2	21.1 ± 1.8
Chromatography						
Carotene fraction	1.5 ± 0.1	3.3 ± 0.5	2.1 ± 0.3	3.4 ± 0.7	9.8 ± 0.5	4.5 ± 1.1
Vitamin A fraction	17.0 ± 0.4	12.8 ± 0.8	17.7 ± 0.8	11.8 ± 0.8	31.8 ± 0.9	16.1 ± 0.4
Total	18.5 ± 0.4	16.1 ± 0.7	19.8 ± 1.0	15.2 ± 1.0	41.6 ± 0.9	20.6 ± 1.9
	"High" carotenoid blood—vitamin A γ%[a]					
No separation	25.1 ± 0.3	25.2 ± 0.3	22.7 ± 0.3	20.0 ± 0.3	36.2 ± 0.8	57.7 ± 4.1
Precipitation of carotene						
Carotene fraction	10.1 ± 0.2	4.5 ± 0.2	6.2 ± 0.4	4.6 ± 0.2	35.9 ± 4.3	7.7 ± 2.7
Vitamin A fraction	16.8 ± 0.4	19.2 ± 0.3	16.4 ± 0.3	19.5 ± 0.3	28.6 ± 1.0	20.6 ± 1.1
Total	26.9 ± 0.2	23.7 ± 0.3	22.6 ± 0.4	24.1 ± 0.5	64.5 ± 4.5	28.3 ± 3.6
Chromatography						
Carotene fraction	6.7 ± 0.1	7.4 ± 0.3	2.9 ± 0.2	4.8 ± 0.3	18.3 ± 0.8	15.0 ± 1.0
Vitamin A fraction	19.4 ± 0.3	17.5 ± 0.5	18.9 ± 0.5	16.7 ± 0.5	38.0 ± 0.8	20.3 ± 1.3
Total	26.1 ± 0.3	24.9 ± 0.4	21.8 ± 0.4	21.5 ± 0.4	56.3 ± 1.4	35.3 ± 1.3

[a] Arithmetic means for six replicates in duplicate ± their standard errors.

increased slightly for chromatography but was decreased markedly for precipitation of carotene.

Parrish *et al.* (17) found that saponification results in lower carotenoid values, which the results of this experiment confirm. The isomerization of β-carotene after heating has been reported (5, 18). Beadle *et al.* (5) found no change in the absorption of β-carotene after shaking with alcoholic KOH for one hour. However, no heat was used in the saponification. It is possible that a hot saponification causes isomerization of β-carotene and other carotenoids to products of lower molar absorbancy index and/or a lower concentration of β-carotene, which might explain the decrease in yellow color after saponification reported here and in Parrish's work. (17).

Plasma vitamin A. Both colorimetric methods gave lower ($P < 0.001$) total vitamin A values (Table 3) than those obtained by measuring the absorption at 325 mμ on the Beckman. For "low" carotenoid blood the Kimble method did not differ from the Sobel method, but for "high" carotenoid blood the Sobel method gave significantly lower values than did the Kimble ($P < 0.05$).

The arithmetic means ± the standard errors for vitamin A from nonsaponified samples determined by the Kimble and Sobel methods and by ultraviolet absorp-

tion, respectively, were: for "low" carotenoid blood, 18.7 ± 0.2, 18.4 ± 0.6, and 36.6 ± 1.6 γ per cent and for "high" carotenoid blood, 26.0 ± 0.2, 22.4 ± 0.2, and 52.3 ± 2.6 γ per cent. For saponified samples the averages for the methods in the same order were: for "low" carotenoid blood 17.2 ± 0.4, 16.0 ± 0.5, and 24.4 ± 1.3 γ per cent and for "high" carotenoid blood 24.6 ± 0.2, 21.9 ± 0.4, and 40.4 ± 2.8 γ per cent. In general, saponification resulted in lower total vitamin A.

Both methods of separating carotene and vitamin A gave total vitamin A values practically identical to no separation. The slight differences which did occur were not significant.

With nonsaponified "high" carotenoid samples separated either by precipitation or chromatography and determined by the Kimble method, significantly higher vitamin A values were obtained than with samples not separated. For the Sobel method "high" carotenoid samples saponified and separated by precipitation of carotene were significantly higher than those saponified and not separated. These results could be due to artifacts or to removal of substances which interfere with the color reactions. It could not be concluded from this experiment which was the case. The use of an internal standard possibly might clarify the situation.

That artifacts are introduced by saponification and by both methods of separation, as far as ultraviolet absorption is concerned, is evident from the values obtained with the Beckman. Actually the values for saponified samples would have been considerably higher if blank corrections had not been made. This was also true to a lesser extent when glycerol dichlorohydrin was used.

Sobel *et al.* (21), in a comparison of the antimony trichloride, glycerol dichlorohydrin, and ultraviolet absorption methods on fish liver oils, found that antimony trichloride gave 1.63 per cent lower and ultraviolet absorption 17.11 per cent higher values for vitamin A than did glycerol dichlorohydrin for the whole oils. For the unsaponifiable fractions antimony trichloride was 4.11 per cent lower and ultraviolet absorption 26.25 per cent higher than glycerol dichlorohydrin. Chilcote *et al.* (10), in a comparison of the above methods plus biological assay, obtained highest values for whole oils with ultraviolet absorption. Antimony trichloride and glycerol dichlorohydrin corresponded more closely with the biological assay which was lowest. Antimony trichloride values were higher than glycerol dichlorohydrin on whole oils but after saponification antimony trichloride values were reduced while glycerol dichlorohydrin values increased.

The results of this study with blood are supported by both of the above comparisons with oils in that highest vitamin A values were obtained with ultraviolet absorption and by the Chilcote *et al.* comparison in that higher values were obtained with antimony trichloride than with glycerol dichlorohydrin.

It was found by Sobel *et al.* (21) and Chilcote *et al.* (10) with oils and by Allen *et al.* (3) with some bovine blood that saponification increases the color produced with glycerol dichlorohydrin. They attributed this to the possible removal by saponification of substances which inhibit the color reaction. Allen,

suspecting that diet might have an influence on the presence of these inhibiting substances, subjected calves to several diets. His results showed that blood from calves on a whole milk diet gave markedly higher vitamin A values after saponification, indicating that something in the milk contributes to the interfering substances. Eaton *et al.* (13) and Thomas *et al.* (22), using antimony trichloride without saponification, found an increase in plasma vitamin A values when animals which had been given large doses of vitamin A were fed skimmilk in place of whole milk. It appears then that fat or fatty acids either interfere with the color reactions or are involved physiologically.

It is believed that any vitamin A ester present in a blood sample is removed with carotene when the separation is performed by precipitation of carotene (7, 17), or by chromatography on alumina (16, 23) and that saponification converts the vitamin A ester to the alcohol form (7, 16, 23). Therefore in the separation of two identical (as far as is known) samples, one of which has been saponified and the other not, one should expect to find less apparent vitamin A in the carotene fraction and more in the vitamin A fraction of the saponified sample. Such was the case when the separation was done by precipitating the carotene, but the reverse was true when chromatography on an alumina column was used to effect the separation. The results are given in Table 3.

Within the limits of the source of blood (calves), of the magnitude of the carotenoids present in the blood, and of the methods and procedures used, it would appear that the tentative method of choice in determining vitamin A content in calf plasma would be the antimony trichloride method without either saponification or separation of the carotenoids. This would be based on the relative simplicity of the method and its adaptability to routine use. In addition, the higher degree of precision as evidenced by the relative small standard error (Table 3) favors the antimony trichloride method.

SUMMARY

Calf plasma containing "low" and "higher" amounts of carotenoids was subjected to the following treatments: saponification without separation of carotene and vitamin A; saponification followed by separation of carotene by precipitation and by chromatography on alumina; and the above treatments without saponification. After treatment, the blood samples were analyzed for vitamin A by the Kimble method on the Evelyn photoelectric colorimeter, by the Sobel method on the Coleman Model 14 spectrophotometer, and by ultraviolet absorption at 325 mμ on the Beckman Model DU spectrophotometer. Carotenoids were determined at 440 mμ on each of the above instruments.

Samples read on the Evelyn were significantly lower in carotenoids than those determined on the Coleman or Beckman. Saponification and both methods of separation resulted in lower total carotenoids. Lower total vitamin A was obtained after saponification. Both colorimetric methods gave lower total vitamin A than ultraviolet absorption for both types of blood. The Kimble method gave significantly higher total vitamin A values than the Sobel method for high carotenoid blood only.

Both methods of separation of carotene from vitamin A resulted in practically the same total vitamin A as samples not separated. Separation of carotene by precipitation was more efficient than chromatography for nonsaponified samples using the amount of yellow color in the vitamin A fraction as a measure of efficiency of separation. After saponification efficiency was drastically reduced in separating carotene by precipitation and slightly increased in chromatography. The amount of vitamin A in the carotene fraction (presumably vitamin A ester) was lower in the chromatographed samples than those separated by precipitation of carotene for nonsaponified samples. After saponification the amount of vitamin A in the carotene fraction decreased when carotene was separated by precipitation but increased when chromatography was used.

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PRODUCTION OF WATER-INSOLUBLE ACIDS AND BUTYRIC ACID IN BUTTER BY DEFECT-PRODUCING BACTERIA [1]

L. T. KESTER,[2] F. E. NELSON, AND I. I. PETERS [3]
Iowa Agricultural Experiment Station, Ames

Ordinarily tests for water-insoluble acids (WIA) and butyric acid (BA) in butter are made for the purpose of determining the quality of the raw material used in the manufacture of a particular lot of butter. Since rancidity and associated changes develop in some lots of butter after manufacture, high WIA and BA values might be associated with development of lipolytic bacteria in butter during storage and merchandising.

The studies reported here were designed to determine something of the degree to which pure cultures of important defect-producing bacteria might be responsible for increases in WIA and BA values under conditions which might be encountered during transportation, storage, and merchandising of butter.

METHODS

Cream pasteurized under commercial conditions at either 150-155° F. or 165° F. for 30 minutes was inoculated with the various test organisms, using 0.1 per cent of 24-hour culture in either litmus milk or broth. The organisms were from the collection in the Dairy Bacteriology laboratories. The cream was churned at once, using small laboratory glass churns. After being rinsed with sterile cold water, the granules were divided into two equal portions. Both portions were worked thoroughly under aseptic conditions, 2 per cent salt being incorporated into one portion. The samples were held in glass containers at 48° F. and examined at the times indicated. Organism counts were not made.

The WIA value was determined by the method of Hillig (3). The BA value was determined by the method of the Association of Official Agricultural Chemists (1).

RESULTS

The data from two experiments are summarized in Table 1. The control samples in both experiments showed essentially no change during the 30-day holding period. *Pseudomonas fragi* caused little change in the salted butter, although there was a tendency for both WIA and BA values to increase slightly in experiment 1; a considerable decrease in the WIA/BA ratio as time of holding increased was apparent in this experiment. In the unsalted butter, *Ps. fragi* caused marked increases in WIA values, the increases continuing throughout the 30-day holding period. The BA values apparently changed but little after

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[2] Present address: Carnation Co., Los Angeles, Calif.

[3] Present address: Dairy Husbandry Dept., Texas A & M College, College Station, Texas.

TABLE 1

Effect of storage at 48° F. on fat hydrolysis by pure cultures added to salted and unsalted butter before churning

Culture added	Days stored	Salted butter (2%)				Unsalted butter			
		WIA[a]	BA[a]	WIA / BA	Flavor criticism	WIA[a]	BA[a]	WIA / BA	Flavor criticism
					Experiment 1				
Control	0	—[b]	—	—	———	115	1.4	82	None
	30	—	—	—	———	85	1.6	53	None
Ps. fragi	6	95	0.8	119	Sl. rancid	637	34.6	18	Rancid
	13	85	1.9	45	Sl. rancid	1,635	105.6	16	V. rancid
	30	150	4.0	37	Sl. rancid	3,165	90.3	35	V. rancid, sl. putrid
Ps. fluorescens	6	90	0.7	129	Ox., sl. rancid	137	3.4	40	Rancid
	13	115	2.9	40	Sl. rancid	270	13.2	21	Rancid
	30	150	5.7	26	Rancid	305	34.0	9	Rancid, sl. putrid
Ps. putrefaciens	6	105	0.3	350	None	116	0.3	387	None
	13	85	1.0	85	None	100	1.5	67	None
	30	72	0.45	160	Sl. putrid	115	—	—	Putrid
					Experiment 2				
Control	0	240	0.8	300	None	240	0.8	300	None
	30	230	0.5	460	None	290	1.0	290	None
Ps. fragi	14	265	3.2	83	None	822	63.9	13	V. fruity
	30	237	2.2	108	Rancid	1,643	70.0	24	Rancid
Ps. fluorescens	14	265	1.6	166	None	250	3.9	64	None
	30	195	1.3	150	None	290	1.6	181	None
Achr. lipolyticum	14	330	—	—	None	697	61.5	11	Sl. rancid
	30	460	6.2	74	None	1,177	23.0	51	Rancid

[a] mg./100 g. fat.

[b] — = not determined.

14 days. In both experiments the WIA/BA ratio reached a minimum after 14 days, but the ratio in contaminated samples at 30 days still was considerably below that usually found for the control samples.

The strain of *Pseudomonas fluorescens* used in experiment 2 had little or no lipolytic activity in butter under the conditions of this study. The strain of *Ps. fluorescens* used in experiment 1 caused some increase in both WIA and BA values in salted butter; a considerable reduction in the WIA/BA ratio was apparent, the BA values increasing much more rapidly than the WIA values. In unsalted butter in experiment 1, *Ps. fluorescens* caused some increase in WIA and a comparatively marked increase in BA. The WIA/BA ratio of 9 at 30 days was the lowest ratio obtained in all of these studies.

Achromobacter lipolyticum caused a considerable increase in both WIA and BA values in both salted and unsalted butters, although the change was much more rapid and extensive in the unsalted butter. The WIA/BA ratios at 30 days were the highest of those found when fat hydrolysis, as indicated by WIA value, was extensive, but the ratio at 14 days in unsalted butter was one of the lowest encountered.

As would be expected of an organism which is non-lipolytic although strongly proteolytic, *Pseudomonas putrefaciens* did not cause any increase in WIA values. BA values were essentially unchanged from those of the controls; the decreases noted in some cases might be due to slight utilization of the acid by the bacteria, but they could be due to the errors inherent in the method of determination.

DISCUSSION

The results indicate that butter made from cream which ordinarily would give an entirely satisfactory product, based upon WIA and BA values, may become unsatisfactory if certain types of defect-producing bacteria have an opportunity to develop and cause lipolysis in the finished product. When either *Ps. fragi* or *Achr. lipolyticum*, both of which contribute to rancidity in dairy products, develops in unsalted butter, both WIA and BA values may become so high as to make the butter liable to seizure under present standards. Strains of *Ps. fluorescens* more strongly lipolytic than the strains used in these experiments may be able to cause similar extensive changes. Salt retards the development of lipolysis caused by these organisms. However, the salt must be incorporated uniformly (5), and the moisture must be dispersed in fine droplets (6) to prevent bacteria from causing defects in butter. Under favorable conditions, either *Ps. fragi* or *Achr. lipolyticum* might be expected to cause increases in both WIA and BA values in salted butter. Even if such butter were made from satisfactory cream, it would be subject to seizure because of the undesirable decomposition which had occurred subsequent to manufacture.

The data are not sufficiently extensive to establish a normal range for the ratio of WIA to BA in butter made from cream which had undergone little or no fat deterioration. Based upon the figures of Hilditch (2) for the amounts of fatty acids normally present in the triglycerides of butterfat, the WIA/BA

ratio in completely hydrolyzed butterfat would be approximately 26. In the churning and washing of the butter much of the BA would tend to go with the buttermilk, so the WIA/BA ratios of 100 or more in freshly churned butter do not seem unreasonable, even if some fat hydrolysis had occurred in the cream. However, the data do indicate that when fat hydrolysis by bacteria has occurred in the butter, the ratio of WIA to BA decreases. Especially in the early stages of extensive lipolysis, the amount of butyric acid present is such as to reduce the WIA/BA ratio to a much lower level than is found with butter which has undergone little or no lipolysis. As the WIA values reach very high levels, the BA values seem to reach a somewhat static level, resulting in an increase in the WIA/BA ratio. In the presence of microorganisms of types other than those which were studied, different relationships might exist.

Lipases usually have been considered nonspecific with respect to action on triglycerides containing different fatty acids, but the results of the present studies might be interpreted as indicating a selective hydrolysis of butyrate esters. Hillig (4) and Peters *et al.* (7), have shown that in some cases the amount of butyric acid present far exceeds the amount which should be present if all of it originated from proportional hydrolysis of butterfat. Hillig (4) has attributed much of the butyric acid to fermentation of lactose. In the present studies, lack of triglycerides containing butyric acid in the substratum probably would not be a limiting factor and lactose or lactate would be present only in limited quantities. However, this would not rule out the possibility that some of the butyric acid might originate from lactose or lactate fermentation products under proper circumstances.

Many more data would need to be assembled before a true evaluation of the WIA/BA ratio could be reached. However, all of the data assembled to date indicate that this ratio might be helpful in recognizing fat hydrolysis due to bacteria developing in butter, since this ratio declined as fat hydrolysis increased.

SUMMARY AND CONCLUSIONS

Butter made from satisfactory cream may become subject to seizure for high water-insoluble acid and butyric acid values if lipolytic bacteria are permitted to grow in the product.

When lipolysis due to bacterial action occurred in butter, the ratio of water-insoluble acids to butyric acid decreased, in some cases very markedly.

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PRODUCTION OF WATER-INSOLUBLE AND BUTYRIC ACIDS DURING CREAM DETERIORATION [1]

I. I. PETERS,[2] L. T. KESTER,[3] AND F. E. NELSON
Iowa Agricultural Experiment Station, Ames

The Food and Drug Administration has seized butter in interstate commerce when water-insoluble acid values of over 400 mg. per 100 g. of butterfat and butyric acid values of over 2 mg. per 100 g. butterfat were obtained. This situation seemed to warrant a study of certain factors influencing cream deterioration and their effects upon the concentration of butyric acid and water-insoluble acids in cream at given stages of deterioration.

In 1947 Hillig (7) proposed a method for the determination of water-insoluble fatty acids (including those present as salts) in cream and butter. Hillig and Ahlmann (8) presented data on water-insoluble acids for 90 churnings of butter; usually when low grade cream was churned a greater quantity of water-insoluble acids was retained in the butter. Data on 321 samples of commercial butter (10) showed that some of these contained much larger quantities of water-insoluble acids than were found even in butter known to have been churned from low grade cream.

Babel (3) found that cream having a clean, acid flavor produced butter with a relatively low water-insoluble acid content, whereas cream having a low acidity but showing evidence of putrefactive types of microorganisms usually produced butter with a high water-insoluble acid content. When lots of the same fresh cream were held for 10 days at 55 and 75° F., no significant differences in the water-insoluble acid content of butter made from such cream were found. Parmelee and Babel (18) found that creameries having difficulty with high water-insoluble acid values tended to produce butter giving higher values in winter and spring than in summer and fall.

In a study on volatile fatty acids in cream and butter, Hillig and Montgomery (9) found that during progressive deterioration of cream, butyric acid, as determined by the method of Ramsey and Patterson (23), frequently was produced in cream when the latter reached a stage of deterioration which made it unfit for human consumption. The results seemed to indicate that butyric acid probably resulted, at least in part, from the breakdown of lactose, rather than from the hydrolysis of butterfat. No determinable quantity of butyric acid was present in butter churned from good cream, or in samples of commercial sweet-cream butter. In a further study (10), butyric acid was found in some of the butters containing large quantities of water-insoluble acids.

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[2] Present address: Agricultural and Mechanical College of Texas, College Station.

[3] Present address: Carnation Co., Los Angeles, Calif.

METHODS

The cream was obtained by mechanical separation of fresh milk of manufacturing quality received daily at the College market milk laboratory. Immediately after separation, the cream was standardized with skimmilk to 30 per cent fat and placed in 4- or 6-l. sterile Erlenmeyer flasks stoppered with sterile cotton plugs. The various portions of unpasteurized cream were incubated at the desired temperatures, and representative samples of 400 ml. each were removed at designated intervals for the various tests. When formaldehyde was used, it was added to the cream at the rate of one part of commercial product to 500 parts of cream.

The butyric acid (BA) value was determined by the method of the Association of Official Agricultural Chemists (2), using 100 g. of cream for each test. The water-insoluble acid (WIA) value was determined by the method of Hillig (7), using 50 g. of cream for each test. The titratable acidity was determined on 9-g. samples by titrating against 0.1 *N* NaOH to the phenolphthalein end point. The pH was determined with a Leeds and Northrup quinhydrone electrode and saturated calomel half cell. The proteolytic counts were obtained by plating cream on tryptone-glucose-extract agar containing 5 per cent added skimmilk, using standard procedure (1). The lipolytic counts were determined by the method of Jensen and Grettie (11), except that the coconut oil was replaced by butterfat. The yeast and mold counts were obtained by plating cream on acidified potato dextrose agar (1). In all instances the plates were counted after incubation for 4 days at 72° F. The Gram stain was used for further identification of microorganisms from colonies on the various plates.

RESULTS

Data from three trials in which different lots of cream were held at several temperatures are assembled in Table 1. In each trial the WIA values were highest at the lowest holding temperature employed. Only the cream held at 38° F. in trial 2 was criticized for any degree of rancidity. Very pronounced flavor defects developed in cream held at 85° F., but the WIA values of such cream did not reach high levels, except after 7 days in trial 1. Although the absolute WIA levels seemed to depend somewhat on the combination of factors influencing lipolysis in the given sample of cream, the values tended to decrease as the incubation temperature of the cream increased from 38 to 85° F. A tendency is apparent for the high WIA values to be associated with the lots of cream in which the pH dropped less rapidly. Many of the lots with pronounced flavor defects had relatively low WIA values.

Extremely high levels of BA were reached after 7 days at 85° F. in trials 1 and 2 and after 10 days at 72° F. in trial 2. These values were reached on samples on which the levels of WIA were comparatively much lower, being hardly changed from the initial WIA value in cream held 7 days at 85° F. in trial 2. Calculation of WIA/BA ratios showed that, although this ratio nearly always decreased somewhat from the values found on the initial cream samples, the

TABLE 1

The influence of incubation temperature and time upon butyric acid value, water-insoluble acid value, titrable acidity, pH and flavor of cream

Inc. temp. (°F.)	Inc. time (days)	WIA (mg./100 g. fat)	BA (mg./100 g. fat)	WIA/ BA ratio	Cream TA[a] (%)	pH	Flavor
Trial 1 (April)							
Init. cream		185	2.9	64	0.17	6.4	Sl. burnt
60	3	62	2.9	25	0.51	4.7	V. bitter
	7	230	14.4	16	0.59	4.7	V. bitter
	10	549	41.5	13.2	0.73	4.6	V. bitter, sl. cheesy
72	3	47	5.8	8.1	0.58	4.7	V. bitter, cheesy
	7	308	18.1	17	0.92	4.4	V. bitter, cheesy
	10	395	14.8	27	0.98	4.3	Bitter, cheesy
85	3	264	51.1	5.2	0.63	4.7	V. cheesy, bitter
	7	412	1,406	0.29	1.75	4.2	V. cheesy
	10	290	780	0.37	2.43	3.9	V. cheesy
Trial 2 (May)							
Init. cream		44	1.0	44	0.13	6.7	Good clean
38	7	1,062	74.5	14.3	0.25	6.2	Sl. rancid
	10	1,457	63.9	22.8	0.28	6.2	Sl. rancid
48	3	139	5.8	24	0.17	6.3	Sl. acid
	7	257	7.4	34.7	0.47	4.8	Sl. unclean
	10	373	13.2	28.3	0.56	4.7	Sl. bitter
60	3	47.5	2.3	21	0.49	4.8	Clean acid
	7	29	6.9	4.2	0.67	4.7	Clean acid
	10	313	4.8	65	0.71	4.4	Sl. yeasty
72	3	31.7	25.5	1.24	0.60	4.6	Clean acid
	7	48.8	11.7	4.2	0.71	4.5	Sl. cheesy, sl. yeasty
	10	149	266	0.58	0.72	4.7	V. yeasty, cheesy
85	3	26.4	21.8	1.21	0.70	4.6	Sl. cheesy, sl. yeasty
	7	47.5	490	0.10	1.10	4.4	V. yeasty, & cheesy
Trial 3 (August)							
Init. cream		35	1.2	29.1	0.15	6.6	Clean, sweet
38	3	594	47.3	12.5	0.20	6.3	Clean
	7	568	99.8	5.7	0.25	6.1	Sl. unclean
60	3	39	23.2	1.7	0.63	5.4	Burnt
	7	35	23.9	1.5	0.90	4.8	Bitter, sl. cheesy
85	3	92	18.4	5.0	0.98	4.7	Bitter, sl. cheesy, sl. yeasty
	7	41	37.2	1.1	1.35	4.3	Cheesy

[a] TA = titrable acidity.

decrease was much less in the samples held at low temperatures than in those held at high temperatures. In four lots held at the higher temperatures, the ratio was considerably less than one.

The data in Table 2 show a marked tendency for Gram-negative short rods to be present in considerable numbers at some time during the holding period of all lots in which considerable amounts of WIA developed. These organisms were not found in large numbers in the samples which did not show increases

TABLE 2

Microbial populations and predominant [a] types in cream held at various temperatures and times

Inc. temp. (°F.)	Inc. time (d.)	Proteolytic count/ml. (millions)	Lipolytic count/ml. (millions)	Yeast count/ml.	Mold count/ml.
			Trial 1 (April)		
Initial cream		No count (M)	0.004 (GNSR)	2	2
	3	No count (M)	0.001 (M)	10	10
60	7	450 (M)	63 (M)	70	10
	10	1,400 (Dip.)	86 (GNSR)	13,000	50
	3	No count (GNSR)	3 (GNSR)	1	1
72	7	800 (M)	0.05 (GNSR)	130	10
	10	700 (Dip.)	0.16 (GNSR)	3,000	5,000
	3	No count (M)	1.2 (GNSR)	9	1
85	7	33 (M)	0.001	40	10
	10	3 (GPLR)	0.001	100	100
			Trial 2 (May)		
Initial cream		0.14	0.002	2	2
	7	17 (GNSR)	16 (GNSR)	7	1
38	10	16 (GNSR)	7 (GNSR)	60	1
	3	30 (GNSR)	4.4 (GNSR)	4	4
48	7	5 (GNSR)	16.0 (GNSR)	10	10
	10	7 (GNSR)	0.6 (GNSR)	100	10
	3	17 (M)	3 (GNSR)	20	1
60	7	400 (Dip.)	0.01	10,000	10
	10	0.001	0.02	3,700,000	50,000
	3	4 (GNSR)	0.02 (M)	10	10
72	7	1,200 (Dip.)	0.04	34,000	100
	10	300 (Dip.)	0.11	2,700,000	200,000
	3	140 (Dip.)	0.001	900	600
85	7	70 (Dip.)	0.001	9,000	1,000
			Trial 3 (August)		
Initial cream		2 (GNSR)	0.15	10	10
	3	12 (M)	2.2 (GNSR)	10	10
38	7	8 (M)	0.1 (M)	10	10
	3	200 (GNSR)	4 (M)	100	100
60	7	120 (M)	0.10	100	100
	3	600 (M)	0.001	12,000	100
85	7	700 (M)	0.001	5,400,000	100

[a] Predominant types of organisms: M = micrococci; Dip. = diplococci; GNSR = Gram negative short rods; GPLR = Gram positive long rods.

in WIA. Only in the lots held for 10 days at 60 and 72° F. in trial 2 and for 7 days at 85° F. in trial 3 were the numbers of yeasts sufficient to have caused any marked lipolysis had they been lipolytic; the data on lipolytic types present in these samples did not indicate that yeasts were responsible for lipolytic changes. In no case was the mold count sufficiently high that molds might have been important factors in butterfat decomposition, with the possible exception

of the lot held for 10 days at 72° F. in trial 2. No characteristic organism type was demonstrated in the samples for which high BA values were obtained.

Since data from a number of sources (3, 16 and others) indicate that high WIA values frequently occur in low-acid cream marketed in late winter and early spring, studies were made to determine whether the natural milk lipase might be a factor of importance in normal lipolysis of milk fat. The data on samples in which microbial development had been minimized by addition of one part commercial formaldehyde (36 per cent) to 500 parts of cream are presented in Table 3. Admittedly, this formaldehyde concentration may inhibit lipase activity somewhat. However, considerable lipase activity is shown under these conditions and data are provided for testing the hypothesis that milk lipase, as well as microbial lipases, may be responsible for some high WIA values. Suitable tests were made to be certain that no significant development of microorganisms occurred in the formaldehyde-treated cream, while large numbers were shown to develop in the untreated cream. The greater acidity of the formaldehyde-treated samples compared to the controls during the early stages presumably is due to the reaction of the formaldehyde. The flavor defects noted in the formaldehyde-treated cream undoubtedly are due, at least in most cases, to the chemical added. WIA values increased in all of the samples

TABLE 3

Effect of formaldehyde addition on WIA content of raw cream after holding

Holding temp. (°F.)	Holding time (d.)	Normal raw cream			Formaldehyde (1:500) added		
		WIA (mg./100 g. fat)	Titr. acidity (%)	Flavor criticism	WIA (mg./100 g. fat)	Titr. acidity (%)	Flavor criticism
Trial 1							
Initial cream		198	0.12	None			
38	2	831	0.20	None	270	0.20	Sl. bitter
	4	1,214	0.24	Unclean	357	0.20	Sl. bitter
	7	1,564	0.26	Unclean	398	0.22	Sl. bitter
60	2	288	0.20	Unclean	277	0.20	Sl. bitter
	4	511	0.72	V. cheesy	311	0.20	Bitter
	7	636	0.72	V. yeasty, cheesy	364	0.20	Burnt
85	2	380	0.72	Sl. bitter, cheesy	338	0.20	V. burnt
	4	441	0.78	Cheesy, yeasty	425	0.22	V. burnt
	7	540	1.23	V. cheesy, yeasty	627	0.25	V. burnt
Trial 2							
Initial cream		50	0.13	None			
38	2	387	0.14	None	67	0.19	None
	4	428	0.16	None	234	0.18	Sl. burnt
	7	502	0.18	None	215	0.20	Sl. burnt
60	2	285	0.16	Unclean	81	0.18	Sl. burnt
	4	65	0.57	Unclean	139	0.18	Burnt
	7	54	0.66	Sl. cheesy	189	0.19	Burnt
85	2	726	0.68	Sl. cheesy, V. bitter	166	0.18	V. burnt
	4	830	0.94	V. cheesy	292	0.19	V. burnt
	7	1,324	1.04	V. cheesy, yeasty	279	0.20	V. burnt

containing formaldehyde, the increase being greatest at 85° F. in both trials. Only in trial 1, where there was evidence of a higher initial lipase level in the product, did the WIA values exceed the standard of 400 mg. of WIA per 100 g. of fat. The reasons for the WIA values at 38° F. being slightly higher than those of the cream held at 60° F. are not readily apparent. These data indicate that milk lipase may be responsible for some lipolysis under conditions where the acidity development is retarded and the reaction is kept at a pH level favorable for activity of the milk enzyme.

The data in Table 3 on the lots of cream not treated with formaldehyde show changes much the same as those commonly encountered in cream held under these conditions. One exception is the relatively high WIA values of the cream held at 85° F. in the second trial. These results, as well as those obtained in a number of other trials, the details of which are not reported here, indicate that WIA values on cream held at 85° F. may reach very high values. Data relative to the type or types of microorganisms responsible were not obtained. The high levels of WIA in cream held at 38° F., particularly in trial 1, are typical of cream held at this temperature.

DISCUSSION

Both normal milk lipase and microbial lipases apparently contribute to high WIA values in cream. Milk lipase probably is not a highly important factor under many circumstances, especially when considerable development of acidity occurs, for this enzyme is not active at an acid reaction (5). However, if cream of high natural lipase content were held for long periods of time under good refrigeration, high WIA values easily might result. As previously indicated, Babel (3) and Parmelee and Babel (18) have reported high WIA values for cream during late winter months. Experience in some commercial laboratories shows the same trend. This trend may be due in part to the fact that the low temperatures favor the development of some of the more lipolytic bacteria of the Gram-negative soil and water types. Nashif and Nelson (13, 14, 15) have shown that low temperatures and neutral reaction favor the production of lipase by *Ps. fragi*, but that acid conditions minimize both production and activity of the enzyme. Nashif and Nelson (16) also have shown that low temperatures favor the production of lipases by many other Gram-negative, non-sporeforming lipolytic bacteria and that the lipolytic activities of these enzymes are favored by a reaction approximating neutrality and much reduced by any marked shifts toward acid reaction.

Purko *et al.* (22) demonstrated that *Geotrichum candidum*, although somewhat inhibited in its lipolytic activity by an acid reaction of the cream, could cause large increases in WIA values when growing in the presence of considerable amounts of lactic acid. Peters and Nelson (20, 21) have shown that *Mycotorula (Candida) lipolytica* can produce considerable amounts of active lipase when growing under acid conditions and this lipase is active in the presence of considerable acid. Gould (5), as well as others, has shown that milk lipase is

markedly reduced in activity at acid reactions. Thus the present data and those in the literature indicate that low temperatures promote lipolysis in cream by providing favorable conditions for production of lipase by common lipolytic bacteria and by retarding acid production and thus favoring action of both microbial and natural milk lipases. When increases in WIA values occur in cream held at high temperatures where acid development is rapid, organisms such as *G. candidum* and *C. lipolytica* may be responsible. The microbiological results in the present studies indicate that these organisms were not a factor. The possibility is not excluded that other microorganisms, especially bacteria, which are not now recognized, may be responsible for increases in WIA values in cream held at high temperatures.

In a number of samples the WIA values declined during holding. Some of the differences are of a magnitude that they might be attributed to inaccuracies of the methods of estimation. However, there is the definite possibility that some of the decreases may be due to utilization of a portion of the acids by microorganisms. Baker (4) and Jezeski *et al.* (12) have demonstrated levels of fatty acid utilization which could account for some of the decreases.

The considerable increases in BA found in some of the samples, especially in cream held at 85° F. in trials 1 and 2 of Table 1, are much greater than could be attributed to any common level of biological fat hydrolysis. Using the average of 13 different analyses for butyric acid in milk fat produced under a variety of conditions as 3.5 per cent (Hilditch, 6) as a basis for calculation, values such as 1,406 mg. of BA per 100 g. of fat would require freeing of almost half of the butyric acid present in the butterfat. Such levels of selective lipolysis are not considered probable. Production of butyric acid from non-fat sources seems the most logical explanation. Hillig and Montgomery (9) attributed the source of butyric acid to lactose. Since the method of estimation employed for this acid does not distinguish between butyric and valeric acids, the possibility exists that valeric acid originating from breakdown of proteins also could contribute to the BA values obtained. However, the data of Peters (19) indicate that this is a very limited possibility, as only small amounts of C_5 and C_6 acids are demonstrable. Breakdown of higher fatty acids with BA as an end product also could be a possible source.

Although BA usually is considered responsible for rancid aroma, the samples with the higher BA values were not criticized for rancidity; criticisms of "bitter" and "cheesy" were encountered much more commonly among these samples, although these criticisms were not confined to samples with high BA values. Information relative to the type or types of microorganisms which produce large quantities of BA in cream held at high temperatures where considerable increase in titratable acidity occurs would be very desirable. The present data offer no clue as to the identity of the causative organism(s).

Using data on butterfat composition as presented by Hilditch (6) and assuming that all fatty acids above C_{10} would be found in the WIA fraction, complete hydrolysis of butterfat would yield a WIA/BA ratio of about 26.3. Ratios appreciably above this were found only with the initial cream used in

trials 1 and 2 and with cream held 10 days at 60° F. in trial 2. The result in the latter case might have been due to selective utilization of BA by the microorganisms present, possibly by the numerous yeasts. The somewhat low ratios where the changes in WIA and BA values have been relatively slight may be attributed, at least in some cases, to inaccuracies of estimation. However, the very low ratios found with some of the lots, particularly those held at the higher temperatures, provide additional evidence that one type of deterioration is being measured by WIA and another by BA values when the latter values are so high as to change the WIA/BA ratio to a level considerably below the theoretical.

SUMMARY AND CONCLUSIONS

Prolonged holding of cream at temperatures below 60° F. favors development of water-insoluble acids. Holding at high temperatures, especially at 85° F., favors development of butyric acid and only occasionally high levels of water-insoluble acids.

Although butyric acid may be freed by lipolysis, much of that found in some samples apparently originated from sources other than direct fat hydrolysis.

Apparently both milk lipase and microbial lipases contribute to fat hydrolysis in raw cream, especially when holding conditions minimize development of acidity.

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DIRECT CHROMATOGRAPHIC DETERMINATION OF ACETIC, PROPIONIC AND BUTYRIC ACIDS IN CHEESE [1, 2]

W. J. HARPER

Department of Dairy Technology,
The Ohio State University, Columbus

New developments in chromatographic techniques have provided the research worker with a long-needed tool for the separation of closely related chemical compounds. In recent years a number of different chromatographic techniques have been developed for the separation of fatty acids (1, 3, 4, 6, 8, 9, 10). Some of these methods involve separation on filter paper, whereas others utilize the flow of mobile phase past a fixed immobile phase suspended in a column. In all of the methods either distillation or extraction of the acids from the parent material has been necessary prior to the application of chromatography. This has been necessitated in part by the failure of the various methods to effect the separation of the lower fatty acids from organic acids such as formic and lactic. Ramsey and Patterson (10) found that pyruvic acid interfered in their procedure for the separation of acetic, propionic, and butyric acids. Another factor which makes distillation or extraction necessary is the interference of the water insoluble fatty acids, which form insoluble salts and block the separation of the lower fatty acids.

Two principal advantages of eliminating distillation or extraction of the acids from the sample are the conservation of time and the more quantitative recovery of the insoluble volatile fatty acids. This study was undertaken to develop a direct chromatographic method for the separation of acetic, propionic, and butyric acids from cheese.

In earlier work (7), paper chromatography was found to be unsatisfactory for the separation of the lower fatty acids; therefore, only column techniques were investigated.

EXPERIMENTAL PROCEDURE

Recently, Bulen *et al.* (2) devised a chromatographic method to separate organic acids in plant tissues. They were able to separate acetic acid from other organic acids by using an acidified silica gel column with H_2SO_4 as the nonmobile phase and different concentrations of N-butanol in chloroform as the moving or mobile phase. Also, these workers used oven-dried silicic acid to insure the preparation of a uniform column and added the sample, dispersed in silicic acid, directly to the column.

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Preliminary experiments using this method revealed several limitations. Although the method separated the lower fatty acids from the organic acids present in the cheese, only partial resolution of acetic, propionic, and butyric acids was obtained. In addition, the volume of the sample and silicic acid could not exceed one-eighth of the total volume of the column without preventing even partial separation.

Moyle *et al.* (8) developed a buffered silica gel column to effect the separation of the lower fatty acids present in a relatively large volume of solvent. In preliminary trials using this method, acetic, propionic, and butyric acids were separated but acetic acid could not be separated from organic acids, such as pyruvic and lactic.

By combining and modifying the methods of Bulen *et al.* (2) and Moyle *et al.* (8), a satisfactory method was developed which permitted the sample (in this case cheese) to be added directly to the chromatographic column and which made possible the separation of acetic, propionic, and butyric acids from the sample. The procedure finally adopted is outlined as follows:

Equipment. 35-mm. O.D. × 250-mm. Pyrex chromatographic tube; 2-in. funnel; 31-mm. perforated porcelain discs; 31.5-mm. filter paper discs; 5-ml. siphon; 5-ml. micro-burrette; 25-ml. Erlenmeyer flasks; and mortar and pestle.

Reagents. Silicic acid (Mallinkrodt, specially prepared for chromatographic analysis No. 2847); pH 6.5 buffer prepared with 2*M* K_2HPO_4 and 2*M* KH_2PO_4; U.S.P. chloroform washed three times with equal volumes of distilled water at 25° C.; 0.5 per cent C.P. n-butanol in chloroform, 1.0 per cent C.P. n-butanol in chloroform, 5.0 per cent C.P. n-butanol in chloroform, 20 per cent C.P. n-butanol in chloroform; 10 per cent H_2SO_4; 20 per cent H_2SO_4; 0.01 *N* KOH in absolute ethanol; phenol red in absolute ethanol (2).

Preparation of silicic acid. Equal volumes of silicic acid and water are mixed together and allowed to stand 30 minutes, the supernatent liquid is decanted, and the process is repeated. The silicic acid then is dried for 48 hours at 100° C., as described by Bulen *et al.* (2).

Preparation of the column. The column is prepared in three separate stages as shown by the shaded areas in Figure 1.

(a) Ten g. of dry silicic acid are mixed in mortar with 6.0 ml. of the pH 6.5 buffer. The resulting free-flowing powder is mixed with 40-50 ml. of washed chloroform until the resulting slurry will pour readily into the column. A filter paper disc on a perforated porcelain disc holds the silica gel in the column. Another filter paper disc is placed on top of the first section. Care should be taken to prevent the inclusion of air bubbles.

(b) Three g. of dry silicic acid are mixed in a mortar with 1.5 ml. of 10 per cent H_2SO_4. This is mixed with 20 to 30 ml. of chloroform and poured into the column when the solvent added with the first section is about 2.4 mm. above the top of the first silica gel part of the column. Care is needed to avoid mixing the two sections. Another filter paper disc is added.

(c) Enough 20 per cent H_2SO_4 is added to 5 g. of cheese to adjust the pH to between 1.7 - 2.0. This must be determined experimentally for each sample

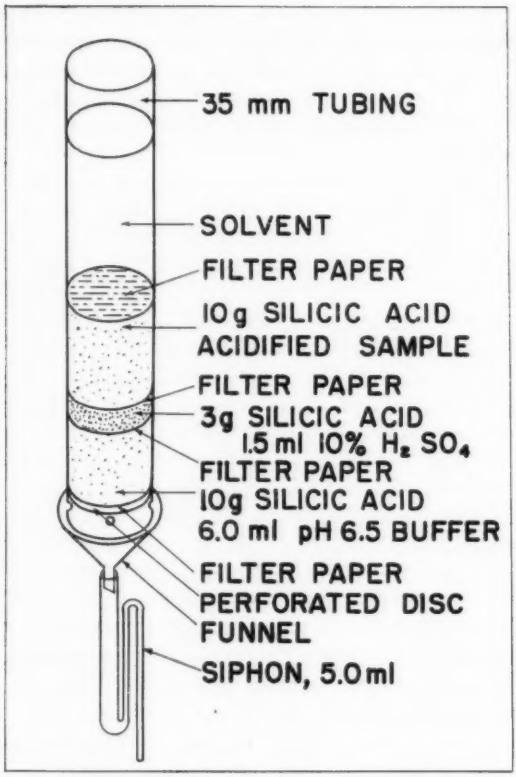

FIG. 1. Chromatographic column assembly for the separation of acetic, propionic and butyric acids.

of cheese. Enough water is added after acidification to bring the total volume of added solute to 3.0 ml. Ten g. of dry silicic acid are added, and the mixture is ground thoroughly. When no cheese particles are apparent, the mixture is prepared for pouring into the column. Fifty ml. of chloroform are used to prepare a free flowing slurry and to wash quantitatively the sample section into the column.

(d) Additional aliquots of solvent are added when the solvent is about 2 mm. above the top of the silica gel column. When the level of the solvent added with the sample section is about 2 mm. above the top of the column, 25 ml. of chloroform are decanted into the column. When only 2 to 4 mm. of this solvent remains above the top of the column, 25 ml. of 0.5 per cent n-butanol in chloroform are added. In like manner the following solvents are added in succession; 50 ml. of 1-per cent n-butanol in chloroform, 75 ml. of 5-per cent n-butanol in chloroform, 100 ml. of 20-per cent n-butanol in chloroform, and additional 20-per cent n-butanol in chloroform to complete chromatogram. Changing the

polarity of the solvent by definite stepwise increases in the concentration of butanol is essential for the separation.

(e) Five-ml. fractions are collected in 25-ml. Erlenmeyer flasks and titrated with 0.01 *N* KOH in absolute ethanol, using phenol red as the indicator.

EXPERIMENTAL RESULTS AND DISCUSSION

Identification of acids. A given volume of solvent is required to elute each acid; this is termed the "threshold volume." For each acid the threshold is a constant which is used as one criterion for identification.

In order to establish the volume of solvent needed to elute a given acid from the column, pure acids were added to the sample portion as individual acids and then in mixtures. With equal molar concentrations, the threshold volume for an acid added individually was not changed when it was added in a mixture of acids. The threshold volumes for a number of fatty and other organic acids, added individually to the sample portion of the column, are given in Table 1.

TABLE 1

Threshold volumes for various fatty acids and other organic acids

Acid	Solvent to elute acid [a]	Acid	Solvent to elute acid [a]
	(ml.)		*(ml.)*
Oleic	50	n-Butyric	155
n-Palmitic	50	Propionic	230
n-Lauric	55	Acetic	285
n-Capric	80	Pyruvic	335
n-Caprylic	85	Formic	410
n-Caproic	90	Lactic	440
n-Valeric	110	Succinic	440

[a] Av. of 3 trials

The threshold volume for an acid should differ by 50 ml. of solvent from any other acid to permit complete separation. The data in Table 1 reveal that this method will separate acetic, propionic, and butyric acid from each other and from other closely related acids. However, oleic acid could not be separated from palmitic and only partially separated from caproic. Nor could lactic acid be separated from formic or succinic, even though it would separate readily from acetic. The observations indicate that the procedure used may be applied satisfactorily to the separation and measurement of pyruvic acid. Butyric and isobutyric acids are not separated by this method.

Application to cheese. Even though the method worked well with pure acids, the separation of the acid from the complex system of cheese had to be established. Both aged and young Italian cheeses were used for the investigation. The acids were identified by their threshold volumes, by addition of known acids to the cheese, and by the method of Ramsey and Patterson (10).

The separation curve, plotting titration value against fraction number, for a 1-day old Romano cheese is shown in Figure 2, and Figure 3 depicts the fatty acid pattern for a 4-month old Romano cheese. These samples did not contain isobutyric acids in detectable concentration. The fat passed through the

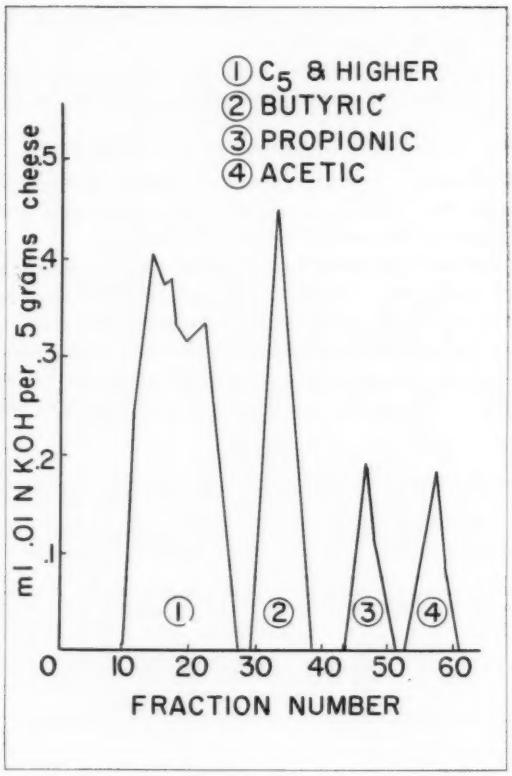

FIG. 2. Chromatographic separation of fatty acids from one-day-old Romano cheese.

column in the first 20 fractions and did not interfere with the separation or titration. The protein and protein degradation products remained in the sample portion of the column, as did the inorganic salts. The organic acids in the cheese did not interfere with the separation by virtue of their higher threshold volumes. The center acid section of the column effectively prevents the organic acids from leaching into the buffered phase and interfering with the separation. The combination of Bulen *et al.* (2) and Moyle *et al.* (8) methods also permits the sample section of the column to make up 50 per cent of the total volume of the column without influencing the results.

In addition to Italian cheese the method was applied to Swiss, Cheddar, and Blue Cheese. In all cases the separation was sharp and complete. A representative distribution curve for a 3-month old Swiss cheese is shown in Figure 4. It shows the separation of acetic, propionic, and butyric acids, and the group of higher acids from one another. Pyruvic acid was separated from the group composed of formic, succinic, and lactic acids. The pyruvic acid

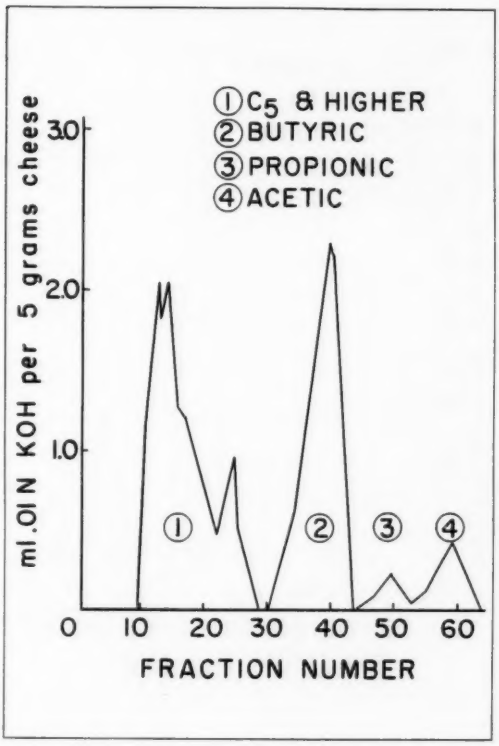

FIG. 3. Chromatographic separation of fatty acids from four-month-old Romano cheese.

was identified by its threshold volume, by the chromatographic analysis of a cheese containing added sodium pyruvate, and by its phenylhydrazone. The characteristics of the phenylhydrazone were identical with those of the phenylhydrazone of pure pyruvic acid.

Pyruvic acid was found in Provolone, Romano, and Cheddar cheese, but its quantitative separation was not determined. Further study is being made in this regard and to establish the significance of pyruvic acid in the cheese ripening process.

Recovery of added acids. To determine the quantitative nature of the method, pure acids were added as sodium salts to cheese, and recoveries were determined. Four trials were made using 0.01 *M*, 0.02 *M*, 0.04 *M*, and 0.05 *M* concentration of each acid. The data in Table 2 reveal that acetic, propionic, and butyric acid were recovered quantitatively. Variation in concentration did not influence the results. Also, other fatty acids such as caproic, oleic, and palmitic, which were added in the same concentrations, were recovered quantitatively as a group composed of C_5 and high acids. The lowest recovery values were ob-

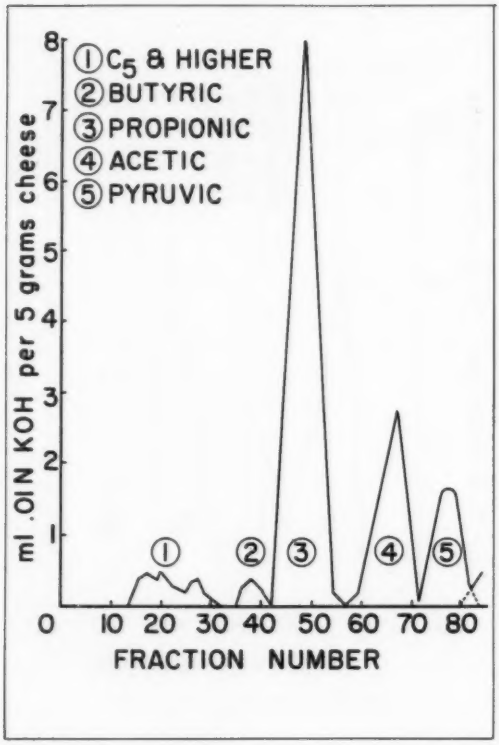

FIG. 4. Chromatographic separation of fatty acids from three-month-old Swiss cheese.

tained for acetic acid. This suggests that a slight esterification may take place in the column, as found by Bulen *et al.* (2) for some organic acids. Loss by volatilization might be responsible in part for the lower recoveries.

Reproducibility of results. Five determinations of acetic, propionic, and butyric acids were made on each of several samples of cheese. As shown by representative data in Table 3 for a typical cheese, the titration values of all three acids were reproduced within $\pm$ 5.0 per cent of the mean, showing that the method will provide reproducible results.

Comparison with other chromatographic methods. As a further criterion to establish the reliability of the method, the results were compared with those obtained by a chromatographic method which utilized steam distillation as a part of the method. The method of Ramsey and Patterson (1) as modified by Hock *et al.* (5) was used for this purpose. The results of this comparison are shown in Table 4. The titration values for acetic and propionic acids obtained by the two methods were in satisfactory agreement, whereas the butyric acid values were consistently slightly higher by the direct chromatographic method. However, no significance is attached to this variation.

TABLE 2

Recovery of fatty acids added to cheese as sodium salts [a]

Sample	Fatty acids				
	Acetic	Propionic	Butyric	Caproic	Oleic and palmitic (1/M. conc.)
	(%)	*(%)*	*(%)*	*(%)*	*(%)*
1-day-old Romano	93.2	94.5	96.2	97.0	93.5
4-mo.-old Romano	92.0	93.2	98.8	94.4	96.4
9-mo.-old Provolone	91.6	97.0	95.1	95.3	97.6
3-mo.-old Swiss	90.9	101.7	95.9	97.2	94.1

[a] Av. of 4 trials, varying from 0.01 to 0.05 millimole added acid.

TABLE 3

Reproducibility of chromatographic results with 9-mo.-old Provolone cheese [a]

Acid	Av. conc. of acid in 100 g. cheese	Range	Av. mean variation
	Millimoles		*(%)*
Acetic	0.31	0.29-0.33	4.2
Propionic	0.35	0.32-0.37	3.7
Butyric	1.24	1.18-1.27	3.2
C_5 and higher	0.86	0.81-0.92	4.9

[a] Data represent 5 separate trials.

TABLE 4

Comparison of direct method with method of Hock et al. for Provolone cheese of different ages

Acid	Millimole acid / 100 g. cheese			
	Direct method		Hock *et al.* method	
	1-day-old	5-mo.-old	1-day-old	5-mo.-old
Acetic	0.65	2.37	0.60	2.45
Propionic	0.50	1.78	0.55	1.80
Butyric	2.10	8.90	2.00	8.75

Application to other dairy products. The method has been used successfully for Romano, Provolone, Swiss, Cheddar, and Blue cheese. In addition, perhaps it may be employed to study the acetic, propionic, and butyric acid content of cheese starters, butter, cream, and powdered milk. Slight variation in the butanol-chloroform concentrations may be necessary in applying this method to other products.

SUMMARY

A simplified direct chromatographic method for the separation and measurement of acetic, propionic, and butyric acids in cheese is described. The new

method does not require the distillation or extraction of the acids prior to analysis. In addition to the lower fatty acids, the method also separates pyruvic acid. The method was compared with a similar chromatographic method requiring distillation prior to analysis. The values obtained with the two methods were almost the same.

Acetic, propionic, and butyric acids added to cheese as sodium salts were recovered quantitatively as acids. Recoveries of acetic acid were less than those of any other acid, but they were more than 90 per cent of the added acid. The titration results were found to be reproducible for all acids within ± 5 per cent of the mean.

The method was found applicable to both young and aged cheese. It has been applied to Provolone, Romano, Swiss, Cheddar, and Blue cheese. In addition, the method may have wide usage for the measurement of acetic, propionic, and butyric acids, which can be made in 4 to 6 hours when running a series of four columns simultaneously.

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CHANGES IN BACTERIAL COUNTS AND FLAVOR OF CONCENTRATED AND RECOMBINED MILKS DURING STORAGE AT LOW TEMPERATURES[1]

J. C. OLSON, JR., A. J. NIELSEN, E. L. THOMAS, AND H. A. MORRIS
Department of Dairy Husbandry, University of Minnesota, St. Paul

During 1950 and 1951 considerable interest developed in the preparation of concentrated milk for home consumption and for use by the Armed Forces. The usual product consisted of whole milk concentrated to approximately 36 per cent solids (3:1). A limited quantity of concentrate containing approximately 44 per cent solids (4:1) was prepared and marketed through military channels. Concentrated milk containing approximately 25 per cent solids (2:1) was introduced in some markets.

There is little published information on the changes in bacterial counts and in flavor which take place in such concentrated milks during storage at various temperatures. Recently, Burgwald, Paxton, and Gould (1) found concentrated milk (3:1) to have excellent flavor when fresh and after 10 days of storage at 34° to 44° F. Concentrate recombined with tap water showed poorer keeping quality than pasteurized milk prepared from the same lot of raw milk which was used in preparation of the concentrate. The poorer keeping quality of recombined milk was attributed to psychrophilic bacteria in the water. Post-pasteurization contamination was demonstrated to be an important factor in keeping quality.

In an unpublished report (3) designed to determine whether concentrated milk can be used at military installations where there may be an inadequate or unsatisfactory supply of fresh milk, it was concluded that this product can be expected to remain acceptable for 45 to 56 days when stored at 30° F. It was found that recombined milk remained acceptable for approximately 13 days when stored at 40° F.

The objective of the studies reported herein was to obtain additional information on the extent of bacterial growth and changes in flavor during storage at low temperature of concentrated milks and their recombined counterparts.

MATERIALS AND METHODS

Three types of concentrated milk used in these studies were (a) commercially processed concentrate packaged in 1-qt. paper containers and intended for distribution through retail market channels, (b) commercially condensed concentrate, homogenized and pasteurized in the laboratory, and (c) concentrated milk which had been processed completely in laboratory equipment.

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Prior to each trial, several quarts of concentrate were pooled. Recombined milk was prepared by diluting concentrate with water. Both products were stored in 4-l. Erlenmeyer flasks with sterile sheets of aluminum foil as closures. Preliminary trials revealed that conventional closures, such as cotton plugs, paper caps, or bakelite caps with cardboard or rubber liners, contributed off flavors, especially after being subjected to sterilization. This interfered with organoleptic examinations. Use of aluminum foil completely eliminated this difficulty.

Bacterial counts and flavor characteristics were obtained initially and at subsequent intervals, usually of 2 or 3 days.

After each storage period, the contents of each flask were agitated, and approximately 100-ml. were transferred to a sterile 250-ml. Erlenmeyer flask. A portion of each sample was used for bacteriological analysis, and the remainder was used for organoleptic examination by two experienced judges. Flavor scores were assigned in accordance with the U. S. Department of Agriculture score card for milk and cream.

Bacteriological examinations consisted of (a) standard plate counts, with incubation at 32° C. for 48 hours; (b) psychrophile counts, with incubation at 7° C. for 10 days; and (c) coliform counts. Tryptone glucose extract milk medium was used for obtaining standard plate and psychrophile counts. Violet red bile medium was used to obtain coliform counts.

EXPERIMENTAL

Keeping quality of commercially processed and laboratory processed concentrated (3:1) and recombined milks during storage at 1°, 4° and 7° C. Preliminary studies of bacterial deterioration of concentrated (3:1) and recombined milks indicated that (a) bacterial growth occurred much more rapidly in recombined milk than in the concentrate from which it was prepared, and (b) concentrated milk remained acceptable in flavor considerably longer than recombined milk when both were stored at low temperatures. In view of these observations, a more inclusive investigation was made of the changes in flavor and bacterial counts during storage of concentrated and recombined milks.

For this study two lots of concentrated milk (3:1) were used. The first was commercially processed and packaged in 1-qt. paper containers and was obtained immediately after filling. This product had been pasteurized at 168° F. for 16 seconds. The second lot consisted of a portion of the same concentrate but was obtained before homogenization and pasteurization. This unprocessed concentrate was homogenized and pasteurized in the laboratory. Pasteurization was at 155° F. for 30 minutes. This heat treatment conformed with military specifications for pasteurization of refrigerated concentrated milk by the holding method (5). The pasteurization procedure was designed to reduce to a minimum the time for the temperature to reach 155° F., thereby avoiding excessive heat treatment and more closely simulating commercial pasteurization. After pasteurization, the concentrate was handled in sterile containers in such manner as to avoid post-

pasteurization contamination. Sterile distilled water was used for recombination of both concentrates, and the temperature of the water was that at which the respective recombined milks were stored (1°, 4°, and 7° C.).

In view of the method of handling, it might be expected that the concentrate which was processed in the laboratory would show maximum keeping quality and would indicate what might be expected in that regard from concentrated milk which had been properly pasteurized and had been protected from post-pasteurization contamination when in the form of either concentrated or recombined milk.

The length of storage periods and the large number of examinations made during each period of storage resulted in voluminous data. Only pertinent data are presented in Tables 1, 2, and 3.

Results after storage at 1° C. The flavor of both concentrated milks remained satisfactory throughout the storage periods, which were 32 and 38 days for the commercially-processed and laboratory-processed products, respectively (Table 1). The recombined milk prepared from commercially processed concentrate became unsatisfactory after 22 days, whereas that prepared from laboratory processed concentrate remained satisfactory in flavor for the full storage period of 38 days.

Although little or no difference in keeping quality was observed between laboratory and commercially processed concentrate, the bacterial counts of the latter were much higher after each interval of storage than those of the former.

Increases in bacterial counts were more rapid in the recombined milks than in the concentrates. Coliform organisms were not detected in either the fresh or stored products.

Results after storage at 4° C. After 25 days of storage at 4° C., the commercially processed concentrate had an unsatisfactory flavor; the recombined

TABLE 1

Bacterial counts and flavor characteristics of concentrated (3:1) and recombined milks after intervals of storage at 1° C.

Days of storage	Standard plate count		Psychrophile count		Flavor characteristics and score [a]	
	Conc.	Recomb.	Conc.	Recomb.	Conc.	Recomb.
	(per g.)	*(per ml.)*	*(per g.)*	*(per ml.)*		
	Commercially processed					
0	34,000	14,000	164	152	a - 37.0	a - 37.0
10	39,000	33,000	1,700	8,800	a - 37.0	a - 37.0
22	28,000,000	200,000,000	26,000,000	200,000,000	a - 37.0	p - 0.0
32	410,000,000	.....	410,000,000	.....	b - 33.0	.....
	Laboratory processed					
0	12,000	4,600	6	22	a - 36.5	a - 37.0
10	20,000	6,900	18	24	a - 37.0	a - 37.0
28	7,000	14,000	< 3,000	3,400	c - 33.0	d - 32.0
38	19,000	8,300	100,000	390,000	d - 32.0	d - 32.0

[a] Legend: a = heated and slightly astringent
b = slightly unclean and bitter
c = astringent and slightly unclean
d = stale and slightly unclean
p = putrid

TABLE 2

Bacterial counts and flavor characteristics of concentrated (3:1) and recombined milks after intervals of storage at 4° C.

Days of storage	Standard plate count		Psychrophile count		Flavor characteristics and score [a]	
	Conc.	Recomb.	Conc.	Recomb.	Conc.	Recomb.
	(per g.)	*(per ml.)*	*(per g.)*	*(per ml.)*		
	Commercially processed					
0	34,000	14,000	164	152	a - 36.0	a - 37.0
7	38,000	46,000	5,200	31,000	a - 36.0	a - 37.0
13	18,000,000	100,000,000	19,000,000	120,000,000	a - 36.0	i - 0.0
25	110,000,000	.....	110,000,000	.....	g - 0.0	.....
	Laboratory processed					
0	12,000	4,600	6	22	a - 36.0	a - 36.0
10	20,000	6,400	13	95	a - 37.0	a - 37.0
19	25,000	110,000	7,000	100,000	e - 34.0	k - 34.0
25	1,300,000	3,000,000	5,300,000	3,000,000	h - 0.0	l - 0.0

[a] Legend: a = heated, slightly astringent; e = astringent, slightly unclean; g = bitter; h = stale, musty; i = unclean, bitter; k = astringent, bitter; l = fermented

TABLE 3

Bacterial counts and flavor characteristics of concentrated (3:1) and recombined milks after intervals of storage at 7° C.

Days of storage	Standard plate count		Psychrophile count		Flavor characteristics and score [a]	
	Conc.	Recomb.	Conc.	Recomb.	Conc.	Recomb.
	(per g.)	*(per ml.)*	*(per g.)*	*(per ml.)*		
	Commercially processed					
0	34,000	14,000	164	152	a - 37.0	a - 37.0
7	9,000,000	30,000,000	11,000,000	30,000,000	a - 37.0	a - 37.0
10	74,000,000	110,000,000	74,000,000	150,000,000	e - 31.0	f - 0.0
13	150,000,000	.....	470,000,000	.....	m - 0.0	.....
	Laboratory processed					
0	12,000	4,600	6	22	a - 36.0	a - 37.0
7	15,000	11,000	.....	2,000	a - 37.0	a - 37.0
10	24,000	520,000	17,000	700,000	a - 37.0	a - 37.0
16	3,500,000	2,100,000	3,000,000	3,500,000	b - 28.0	f - 0.0
19	5,000,000	3,800,000	5,600,000	18,000,000	p - 0.0	.....

[a] Legend: a = heated, slightly astringent; b = slightly unclean, bitter; e = burnt, slightly malty; f = bitter, fermented; m = malty; p = putrid

product was unsatisfactory after 13 days (Table 2). At the time flavor was considered unsatisfactory, standard plate counts and psychrophile counts of both products had reached approximately 100,000,000 per gram of concentrate and per milliliter of recombined milk.

The flavor of laboratory processed concentrate and the same product when recombined became unsatisfactory after 25 days; however, bacterial counts increased more rapidly in the recombined milk than in the concentrate. The recombined milk from laboratory processed concentrate remained satisfactory in flavor for 12 days longer than the recombined milk prepared from commercial concentrate.

The difference in bacterial counts associated with unsatisfactory flavor in the various products was striking. This had been observed in previous trials and may be accounted for, in part, by differences in bacterial types which predominated in the different products during storage and at the time flavor deterioration became evident. No coliform bacteria were detected at any time.

Results after storage at 7° C. Keeping quality was considerably shortened by storage at 7° C. (Table 3). After 13 days the commercially processed concentrate became unsatisfactory; the recombined milk became unsatisfactory after 10 days.

Somewhat longer keeping quality was shown by the laboratory processed products, being 19 days for the concentrate and 16 days for the recombined milk.

The flavor of the commercially processed products became unsatisfactory when bacterial counts had reached approximately 100,000,000 per gram or milliliter; the laboratory processed products showed unsatisfactory flavor with counts under 10,000,000. The same relationship was observed during storage at 4° C. Coliform bacteria were not detected in any of the products when fresh or after storage.

Comparison of the keeping quality of 44 per cent concentrated milk (4:1) with the same product when diluted to 36 per cent (3:1) and 12 per cent (recombined) total solids. Some interest has been manifest in the manufacture and distribution of concentrated whole milk containing approximately 44 per cent total solids and commonly known as 4:1 concentrate. This product has been produced in limited quantity and has been available at certain military establishments. Concurrent with studies on the more common 3:1 concentrate, a study of the bacterial and flavor changes which might occur during storage of 4:1 concentrated milk was undertaken. In addition, it was desired to learn whether a 4:1 concentrate might possess any advantage from the standpoint of keeping quality over that possessed by less concentrated milks.

Whole milk was preheated, homogenized, and concentrated to 44.3 per cent total solids. Concentration was done in a laboratory evaporator operating through a temperature range of 30° to 37° C. Pasteurization was accomplished as previously described. Portions of the concentrate were transferred to six sterile 2-l. Erlenmeyer flasks having aluminum foil closures. Sufficient sterile distilled water was added to two of the flasks to dilute the concentrate to 36 per cent total solids (3:1) and to two of the remaining flasks to dilute the concentrate to 12 per cent total solids. One flask of each product was stored at 1° and 7° C. Bacterial analyses and organoleptic examinations were made at intervals of 2 to 3 days, as previously described.

A portion of the data which were obtained during storage at 1° C. is presented in Table 4. All products remained satisfactory in flavor for 40 days, at which time storage was terminated. Bacterial counts of the 4:1 and 3:1 concentrates remained essentially unchanged. Bacterial counts of the recombined milk increased steadily during storage but did not become sufficiently high to affect flavor.

Results obtained during storage at 7° C. (Table 4) reveal rather striking dif-

TABLE 4

Bacterial counts and flavor characteristics of concentrated (4:1 and 3:1) and recombined milks after intervals of storage at 1° and 7° C.

Days of storage	Standard plate counts			Psychrophile counts			Flavor characteristics and score [a]		
	(4:1)	(3:1)	Recomb.	(4:1)	(3:1)	Recomb.	(4:1)	(3:1)	Recomb.
	(per g.)	*(per g.)*	*(per ml.)*	*(per g.)*	*(per g.)*	*(per ml.)*			
				After storage at 1° C.					
2	1,600	1,800	1,000	0	0	0	n - 36.0	n - 36.0	n - 36.0
23	560	390	900	< 30	0	610	n - 36.0	n - 36.0	n - 36.0
40	160	200	620,000	< 300	< 300	700,000	s - 34.0	s - 32.0	s - 32.0
				After storage at 7°C.					
2	1,900	1,700	1,100	0	0	0	.....	.....	.....
5	5,500	3,700	1,300	0	0	22	.....	.....	.....
10	3,000	23,000	300,000	400	20,000	320,000	.....	.....	.....
13	6,600	1,300,000	43,000,000	1,900	1,100,000	3,800,000	.....	.....	.....
20	490,000	4,600,000	130,000,000	320,000	4,100,000	120,000,000	.....	.....	.....
23	.....	5,300,000	130,000,000	550,000	4,600,000	100,000,000	.....	.....	.....

[a] Legend: n = astringent, heated, feed
s = stale, astringent

ferences in rate of bacterial growth among the three products; growth increased greatly as the concentration of milk solids was reduced. As the result of an error, samples which were stored at 7° C. were placed in a refrigerator which contained plates being incubated to obtain psychrophile counts. Odors arising from these plates were absorbed by the milk samples, thus rendering flavor scores and comments of no value in indicating flavor deterioration attributable to bacterial activity. In a series of preliminary trials, using commercially processed 4:1 concentrate for preparation of the 3:1 and recombined milks in the manner described above, it was observed that approximately one week additional storage life at 5° C. was shown by the 3:1 concentrate over the recombined milk, and an additional week was shown by the 4:1 over the 3:1 concentrate. In view of these results and the differences in bacterial counts as shown in Table 4, it is likely that similar differences in keeping quality among the three products would have occurred.

Coliform bacteria were not observed to increase during storage at any of the three temperatures.

DISCUSSION AND SUMMARY

From the results of these studies it is evident that bacterial growth took place at an appreciably greater rate in recombined milk than in the concentrated milk from which it was prepared. Bacterial growth was associated with flavor deterioration, as poorer keeping quality was obtained with recombined than with concentrated milks.

In studies which were designed to indicate what might be expected by way of keeping quality of concentrate which had been prepared under ideal sanitary conditions after proper pasteurization, approximately 2, 3, and 5 weeks of satisfactory keeping quality were obtained after storage at 7°, 4°, and 1° C., respectively. Generally, these periods of satisfactory keeping quality were longer than those observed with commercially processed concentrate, although in certain trials, including those reported in Tables 1 and 2, commercial concentrated milk showed excellent keeping quality. Differences which have been observed undoubtedly have been influenced greatly by the amount and type of post-pasteurization contamination which occurred.

Coliform bacteria did not appear to play a role in flavor deterioration of the products used in this study. As a matter of fact, coliforms were found to increase in only one of the trials preliminary to those reported. This was expected, for considerable work, notably that of Dahlberg (2), has shown that coliform bacteria do not grow rapidly in pasteurized whole milk at or below the storage temperatures used in these studies. Similar results have been obtained in our laboratories (4), although occasional samples have indicated the presence of coliforms capable of rapid growth.

Since concentrated milk is used mainly in the form of recombined milk, the results obtained during storage of that product are of some interest. It is evident that recombined milk may remain acceptable in flavor for considerably longer than the usual storage period in the household refrigerator before ultimate con-

sumption. In this connection it should be emphasized that the data reported were from results obtained using water for recombination which was at the temperature used for storage of the respective products. Consumer handling may vary considerably. During summer months it is conceivable that water used for recombination may in some areas reach a temperature of 70° F., or higher. This and subsequent conditions of handling may influence greatly the extent of bacterial growth and keeping quality. Studies are in progress to assess the effect of various factors which might influence the keeping quality of recombined concentrated and dried milks.

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CATABOLIC REACTIONS OF MIXED SUSPENSIONS OF BOVINE RUMEN BACTERIA [1]

RAYMOND N. DOETSCH, ROSLYN Q. ROBINSON,
RICHARD E. BROWN, AND JOSEPH C. SHAW
Departments of Bacteriology and Dairy Husbandry, University of Maryland, College Park

In contradistinction to cultural investigations, the catabolic activities of bacteria of the bovine rumen have been studied but little. In several instances (16, 17, 21) pure cultures have been examined, but these reports deal mainly with bacteria obtained from sheep. There is also some equivocation as to what criteria should be used to determine the importance of an organism isolated from the rumen. Because of this and other difficulties a method for the differential centrifugation of rumen contents has been suggested (17) which supplies a mixed suspension of many of the bacteria contained therein. Although this procedure provides an arbitrarily selected fraction of the total bacterial flora of the rumen, it can be employed under standardized conditions to give some indication of comparative biochemical activity. Washed suspensions of bacteria from sheep rumen contents have been used previously (9, 10, 11, 18, 22) for studying specific biochemical transformations. Of the various methods used for study (4), this method possesses certain distinct advantages over pure culture examination of rumen contents. Elsden (8) has pointed out that if one does not know what bacteria to look for specifically, it is difficult or impossible to know what to isolate. The result is usually a miscellaneous collection of cultures whose significance is difficult to ascertain. The use of washed suspensions allows one to study a controlled, nonproliferating population which exhibits little activity in the absence of an added substrate. In addition, the experimental time is short and only small amounts of substrate are required. It is obvious that this method allows for precise control of experimental manipulation. The assumption is made that from experiment to experiment, the bacterial population is fairly constant, qualitatively as well as quantitatively. Some organisms attached to particulate matter are probably lost, and in certain cases enzymatic inactivation may occur as a result of the processing technique (11, 22). Finally, the reactions uncovered in this manner should be verified, whenever possible, in vivo.

In this paper data are presented on the catabolic metabolism, under anaerobic conditions, of mixed suspensions of bovine rumen bacteria on compounds considered to be important in the physiology of the ruminant. It is the purpose of this work to attempt to define more clearly the nature of the transformations brought about by rumen bacteria. It is evident that once basic biochemical mechanisms of the rumen are uncovered, the problem of devising media for

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isolating specific bacteria capable of bringing about these reactions is simplified and clearly defined (13).

EXPERIMENTAL

Rumen samples taken at the same time each day were obtained from an 8-year-old Holstein cow fed alfalfa hay and a grain mixture containing 16 per cent protein. This animal was fitted with a rumen fistula, and in each instance samples were taken 5 hours after feeding. The sediment resulting from centrifuging (771 g.) 1 liter of rumen liquor in round bottom (200-ml.) flasks (22) was separated further into a lower green fraction and an upper white fraction by centrifuging 1 minute (1,952 g.) in conical 15-ml. tubes in an angle head centrifuge. The white fraction contained almost exclusively bacteria and was used in these experiments. The green fraction contained residual plant material and some remaining protozoa and bacteria. All cell suspensions were tested within 2 hours after removal of the rumen sample from the test animal.

The white fraction was suspended in 0.066 M phosphate buffer at pH 6.9, previously boiled and cooled, to which was added 0.02 per cent (w/v) $Na_2S \cdot 9H_2O$. This suspension was standardized so that 0.1 ml. added to 9.9 ml. of distilled water resulted in an optical density reading of between 0.08 and 0.1 when determined by using a Klett-Summerson (model 800-3) photoelectric colorimeter (560 mμ filter). Cells prepared in this fashion were used both for manometric studies and dissimilation tests, as described below.

All substrates were prepared immediately before use in the above mentioned buffer. Maltose, cellobiose, glucose, and the sodium salts of ethyloxalacetic, succinic, malic, fumaric, β-hydroxybutyric, lactic, pyruvic, propionic, acetic, and formic acids were used in the manometric studies.

Standard procedures carried out as outlined by Umbreit *et al.* (23) were employed in the following studies. Each double-side arm Warburg flask contained 1 ml. of standard cell suspension in the main chamber (dry weight, 4.8-9.6 mg.), 0.5 ml. substrate, and 0.3 ml. of 10 *N* H_2SO_4 in the side arms, and a duplicate flask contained 0.1 ml. of 25-per cent KOH in the center well. The substrate concentrations used are given in Table 1. The final volume in all flasks was made up to 3.0 ml. with previously boiled 0.066 *M* phosphate buffer

TABLE 1

Substrates utilized by rumen bacteria with gas evolution

Substrate	μM conc. / respiration flask	μL gas evolution in 1 hr. at 39° C.		
		Total	CO_2	Other
Cellobiose	4	61	61	0
Maltose	4	121	69	52
Glucose	8	46	46	0
Pyruvate	16	212	160	52
Succinate	12	215	215	0
Fumarate	12	199	199	0
Malate	12	316	316	0
Lactate	16	45	34	11
Formate	48	110	54	56

(pH 6.9) with 0.02 per cent (w/v) $Na_2S \cdot 9H_2O$ added. Anaerobic conditions were obtained by gassing the flasks for 10 minutes with nitrogen freed from traces of oxygen by passing over hot copper filings. The reaction was carried out for 1 hour at 39° C. ± 0.1, after which time the contents of the flask were acidified and total gas evolution was determined. Control flasks without substrate were used both with and without added KOH in the case of carbon dioxide determinations. Each substrate used was run eleven different times.

Dissimilation tests were made to obtain a sufficient quantity of end products for determination of lactic, total keto acids, and volatile fatty acids. For this study, 50-ml. Erlenmeyer flasks were used. Each flask contained 3.0 ml. of cell suspension, 4.0 ml. of substrate, and 4.0 ml. of buffer. A substrate concentration of 155 μM per flask was used in the results shown in Table 2. Anaerobic conditions were obtained by gassing for 2 minutes with oxygen-free nitrogen and sealing with a rubber stopper equipped with a manometer and a gas release valve. The flasks were incubated in a water bath at 39° C. ± 0.1 for 5 or 24 hours. At the end of this time 2 ml. were withdrawn for lactic acid determination (2) and total keto acids (12). The remaining contents of the flask were acidified with 4.0 ml. of 10 N H_2SO_4 and used for the determination of volatile fatty acids. Control flasks, without substrate, were examined at 0 hour, 5 hours, and 24 hours and contained 8.0 ml. of buffer and 3.0 ml. of cell suspension. Each substrate used in this determination was examined on six separate occasions.

Volatile fatty acids were determined chromatographically by the method of Elsden (7) except that the "alphamine Red R" indicator of Liddell and Rydon (19) was used on the column instead of brom-cresol green.

RESULTS

A summarization of the typical results of this investigation is presented in Tables 1 and 2. A number of observations may be made from them although

TABLE 2

End products of substrate fermentation by rumen bacteria

Substrate (155 μM)	μM total fatty acids recovered	μM volatile fatty acids			Iodine [a] test
		Acetic	Propionic	Higher acids	
Cellobiose	180	110	40	30	+
Maltose	243	87	99	57	+
Glucose	148	86	39	23	+
Xylose	114	45	34	35	+
Pyruvate	116	78	23	15	0
Lactate	..... [b]	....	....	....	0
Oxalacetate	24	.... [b]	....	....	0
Succinate	176	21	141	15	0
Fumarate	24	24	0	0	0
Malate	125	68	48	9	0
Formate	15	15	0	0	0
Acetate	100	100	0	0	0
Propionate	137	14	123	0	0
Butyrate	285	262	0	23	0
β-OH-butyrate	39	25	8	6	0

[a] Lactic and keto acids negative on all substrates.
[b] Yield too small for further fractionation.

it is stressed that the values presented are significant qualitatively and that the absolute yield of end-product varies with incubation time, processing time of the cell suspensions, cell concentration. etc.

Cellobiose and glucose were attacked by the rumen bacteria with the production of carbon dioxide as the sole gaseous end-product. It is interesting to note that Sypesteyn and Elsden (22) reported the same observation. Hungate (15) found that certain pure cultures of cellulolytic bacteria isolated from the rumen produced only carbon dioxide from cellulose fermentation, whereas others produced hydrogen in addition to carbon dioxide. Maltose, however, yielded carbon dioxide and another gas, or gases, as well. This carbohydrate was attacked much more vigorously, as judged by gas evolution, than either cellobiose or glucose. Qualitative tests showed that none of the substrates were completely dissimilated in 5 hours but all were used after 24 hours incubation.

Formate was the only volatile fatty acid dissimilated with the formation of gaseous end-products. In this case equal quantities of carbon dioxide and, presumably, hydrogen were evolved. The reaction is carried out rapidly and indicates the presence of hydrogenlyase-containing microorganisms. Beijer (3) found formate to be an excellent source of methane in the goat rumen.

Acetate, propionate, butyrate, and β-hydroxybutyrate were not attacked with the formation of gaseous end-products.

In the case of succinate, fumarate, and malate the gas produced was again found to be exclusively carbon dioxide. Lactate and pyruvate must be dissimilated via other pathways since gases in addition to carbon dioxide were evolved.

With the exception of formate, lactate, and ethyloxalacetate, the compounds investigated were metabolized, in part, to volatile fatty acids. When carbohydrates were the substrate, a mixture of acetic, propionic, and higher fatty acids was produced. Malate, pyruvate, and β-hydroxybutyrate also were metabolized, in part, to these products. In nearly all instances, except maltose and succinate, acetic acid was the major volatile fatty acid produced. Fumarate yielded only acetic acid. Fatty acids, other than formic, when metabolized, yielded only acetic acid as an end-product.

At no time during the course of this study were lactic or keto acids produced from the compounds investigated. However, bacterial suspensions capable of forming lactic acid from carbohydrates have been obtained from animals fed hay-starch diets. Phillipson and McAnally (20) showed that lactic acid was not produced when hay, starch, or cellulose was fed, but this acid could be demonstrated after glucose administration. In this regard Hungate *et al.* (14) reported that large quantities of grain or glucose fed to sheep resulted in lactic acid production sufficient to reduce markedly the pH of the rumen ingesta.

After 24 hours incubation iodine tests on the substrates shown in Table 2 resulted in blue colorations with the carbohydrate substrates, but with no others. Polymerization reactions involving these compounds are being further investigated.

The above reactions were found to be the same from day to day but varied

somewhat in magnitude. It is assumed that this was due to minor variations in the activity of the flora itself.

DISCUSSION

Rumen bacteria are capable of dissimilating a number of compounds known to be involved in important metabolic processes. There are several points which should be emphasized further. The volatile fatty acids apparently are not vigorously attacked by the rumen bacteria. Presumably they are chiefly final end-products and are removed principally from the rumen by absorption. In the case of the volatile fatty acids higher than acetic, they may be degraded to acetic.

Pyruvate is always vigorously attacked and is not long detectable in a cell-substrate mixture (gone after 5 hours). All of the volatile fatty acids of importance in the rumen are produced from this substrate. The ease with which it is attacked suggests that the rumen bacteria are generally in contact with it. This is further borne out by the fact that keto acids are found in the rumen liquor in only trace amounts, which indicates that pyruvate, at least, must be metabolized as rapidly as it is formed.

Succinate degradation has been previously studied by Sypesteyn and Elsden (22) and Johns (16), and the present work confirms their observations. Lactate is not attacked with the production of detectable volatile fatty acids, and fumarate yields solely acetic acid in small amounts.

With regard to carbohydrate dissimilation cellobiose yields the same ratio of fatty acids as glucose, xylose, and pyruvate. In dissimilation tests it was not completely used in 5 hours but was after 24 hours incubation. Maltose yields more propionate than acetate and also a gas or gases in addition to carbon dioxide. It should be borne in mind that if the reactions were carried out under different gaseous atmospheres, or with mixed suspensions of bacteria from animals on markedly different diets, or if different pH levels were employed, different end-products might be found.

The above reactions bear out the views of Baker (1), wherein the rumen process was considered a functional field. From the reactions discussed above it is apparent that the variety of substrates attacked by the rumen bacterial flora result in the production of some volatile fatty acids. Any food substance which would be attacked by rumen bacteria might ultimately be expected to follow a common pathway to some final end-product.

From the results of this study the essentially anaerobic mechanism of rumen processes is borne out. The whole process is one involving low-energy yielding anaerobic dissimilations. It should be noted here that Doetsch *et al.* (6) have observed that rumen suspensions are able to oxidize substrates in the presence of an atmosphere of air. Maltose and glucose are oxidized rapidly, whereas acetate is not oxidized to any extent. None of the substrates are oxidized to completion, and, indeed, a sharp decrease in oxygen uptake is noted after 20 to 25 minutes. This suggests the accumulation of inhibitory substances. It also shows that the rumen flora is well adapted to its environment and does not operate well in the presence of an atmosphere of air.

The results obtained from investigations of this sort may be applied to ruminology of the bovine in a variety of ways. For example, substrates of known composition shown to be actively dissimilated by this technique, may be added to the rumen in an effort to modify the chemical environment therein. Indeed, for experimental purposes, one might hope to increase the concentration of specific metabolic compounds in the rumen. In this regard it has been found that succinate, fed to a fistulated Holstein cow, increases the propionate level from 21.0 per cent to 48.6 per cent of the total volatile fatty acids in the rumen in 1.5 hours, thus verifying in vivo the results obtained in vitro. The method also might lend itself to a determination of the possible chemical pathways by which specific compounds are dissimilated in the rumen. It is obvious that the more removed the compound under investigation is from the starting substrate, the more difficult the task of analysis becomes. At least one could eliminate totally improbable compounds from further consideration. There is also the possibility of determining the extent to which variations in diet, antibiotics, disease, and other conditions alter the activity of the rumen bacteria on specific substrates. Finally, the reactions found to be brought about by the rumen bacteria should be used as the basis for construction of media suitable for isolation of bacteria able to perform specifically certain transformations.

The technique originated by Elsden (8) and his co-workers not only has opened up possibilities in the above directions but may serve as the basis for perfecting techniques for rapid screening procedures of the biochemical potentialities of the rumen bacterial flora.

SUMMARY

A number of substrates of known importance in metabolic processes have been tested under anaerobic conditions with mixed suspensions of bovine rumen bacteria. The gases and volatile fatty acids produced from these substrates have been characterized. On the basis of the results obtained recommendations are made for the practical application of the technique to the solution of problems involving bovine rumen bacteria.

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EFFECT OF VARIOUS DIETARY LIPIDS ON THE BLOOD PLASMA LIPIDS OF DAIRY CALVES [1, 2]

N. L. JACOBSON, J. H. ZALETEL, AND R. S. ALLEN
Departments of Dairy Husbandry and Chemistry,
Iowa Agricultural Experiment Station, Ames

Previous work (24) has demonstrated quantitative changes in blood plasma lipids of the dairy calf during early post-natal development. Moreover, it has been shown (5, 10, 12, 13, 15, 22) that type of dietary lipid has a marked effect on the blood plasma values (Allen method, 2) and on the growth and general well-being of the dairy calf. Therefore, it seemed desirable to determine the quantitative interrelationships of the plasma lipid fractions of calves subjected to various dietary regimes and to determine whether these interrelationships are associated with other physiological responses.

The present study was initiated to evaluate the effect of various dietary lipids upon the following blood plasma lipid fractions: neutral fats, phospholipids, free cholesterol, ester cholesterol, ester fatty acids, and free fatty acids.

EXPERIMENTAL

Fifteen calves, ten Holsteins and five Brown Swiss, were divided into five comparable groups. For 3 days following birth the calves remained with their respective dams. Subsequently, the animals were placed in individual stalls bedded with wood shavings; from 4 to 18 days of age they were fed whole milk (approximately 3 per cent fat). During the ensuing 28-day period group I continued to receive whole milk, whereas groups II, III, IV, and V were fed reconstituted milks containing butteroil, crude soybean oil (expeller), hydrogenated soybean oil, and lard, respectively. The reconstituted milks contained 10 per cent nonfat dry milk solids and 3 per cent oil or fat and were homogenized at a pressure of 3,000 lb. All milks were fed twice daily, via nipple feeders, at the rate of 10 lb. per day per 100 lb. body weight. Each calf received daily 15,000 I.U. of vitamin A and 3,000 I.U. of vitamin D in gelatin capsules. No other feeds were offered. Whenever scouring occurred, the amount of milk fed was reduced by 50 per cent. After the diarrhea subsided, the intake was increased gradually to the normal level .

Samples of venous blood (heparin anticoagulant) were drawn about 3 hours after the morning feeding, when the calves were approximately 11 days of age and at weekly intervals thereafter. After centrifugation of the blood, the lipids of each plasma sample were extracted with alcohol-ether (3:1) using a solvent: plasma ratio of 20 to 1. This extract was analyzed for neutral fats, phospholipids, free cholesterol, ester cholesterol, ester fatty acids, and free fatty acids, as

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described by Zaletel *et al.* (24). In addition, the plasma fat level for each sample was determined by the Allen method (2).

RESULTS

As shown in Figure 1, the plasma total lipids rose sharply for each dietary group during the preliminary whole milk feeding period. Except for the group which received whole milk during the experimental period, however, there was a marked decline in the total lipid values 1 week after initiation of the experimental milk feeding. Subsequently, the group fed crude soybean oil showed a marked increase in plasma total lipid levels, and at 3 and 4 weeks the levels approached those of the whole milk group, whereas the increases shown by the butteroil and lard groups were much smaller. Consumption of hydrogenated soybean oil resulted in an initial abrupt decline and a subsequent gradual decrease in the plasma total lipids throughout the experimental period.

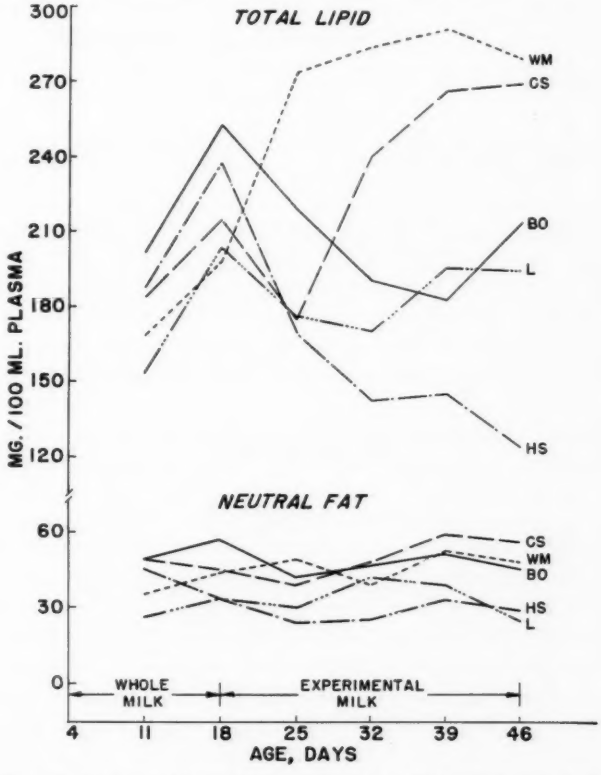

FIG. 1. Effect of dietary lipids on blood plasma total lipids and neutral fats. (W M = whole milk, B O = butteroil, C S = crude soybean oil, H S = hydrogenated soybean oil, L = lard.)

Except for differences in magnitude of values, results similar to those observed for the plasma total lipids also were noted for Allen fat (Figure 2), for ester and free cholesterol (Figure 3) and for ester fatty acids (Figure 4). In most cases the maximum effect of the dietary lipids on the plasma lipid fractions apparently was attained after 3 to 4 weeks of experimental milk feeding.

Although the plasma neutral fat levels in the various groups were somewhat erratic (Figure 1), the results indicate that the hydrogenated soybean oil and lard groups had values lower than those for other groups. Similarly, the changes in phospholipid values (Figure 2), despite a high degree of variability, suggest certain trends, the greatest contrast being observed between the whole milk and hydrogenated soybean oil groups. When a change to experimental milks was made, phospholipid values declined in all groups fed reconstituted milks, and

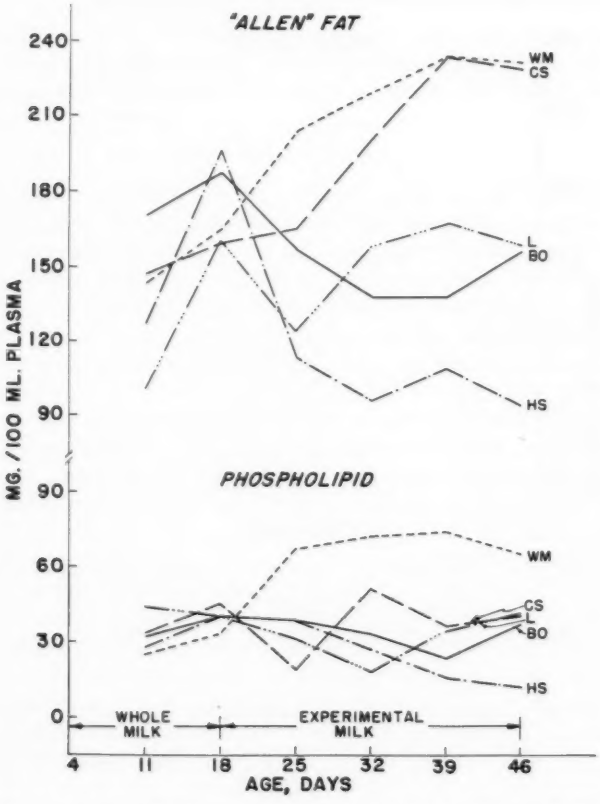

FIG. 2. Effect of dietary lipids on blood plasma Allen fat and phospholipids. (W M = whole milk, B O = butteroil, C S = crude soybean oil, H S = hydrogenated soybean oil, L = lard.)

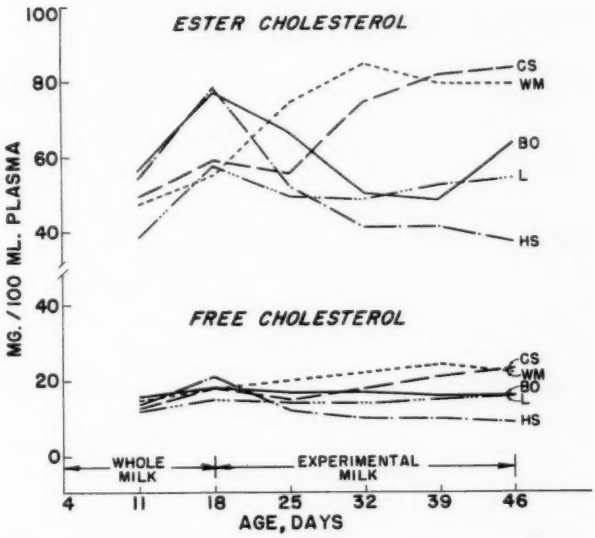

FIG. 3. Effect of dietary lipids on blood plasma ester and free cholesterol. (W M = whole milk, B O = butteroil, C S = crude soybean oil, H S = hydrogenated soybean oil, L = lard.)

the hydrogenated soybean oil group was the only one which did not show a subsequent rise. The marked changes observed in the crude soybean oil group possibly may be attributed in part to variations in the phospholipid content of the oil as fed. No definite trends were observed in the free fatty acid levels in the various dietary groups (Figure 4) except that the lard and hydrogenated soybean oil groups appeared to have levels somewhat higher than those exhibited by the other groups.

A comparison of the values for the various plasma lipid fractions at the termination of the preliminary whole milk feeding period with the corresponding averages of values after 3 and 4 weeks on the experimental milks is presented in Table 1. Although there were considerable within- and among-calf variations, most of the plasma lipid fractions in the whole milk and crude soybean oil groups were higher during the experimental period than those recorded at the end of the preliminary period, whereas in most instances markedly lower values in the experimental period were found in the group fed hydrogenated soybean oil. Lesser changes were observed in the groups fed butteroil and lard.

Percentages of the various lipid components in the total plasma lipids and of ester cholesterol in total cholesterol were calculated, and pertinent data are summarized in Table 2. These data indicate that the type of dietary lipid had comparatively little effect on the per cent of the various fractions in the total plasma lipid, the greatest deviations occurring in the hydrogenated soybean oil group wherein the free fatty acid percentage was higher and the phospholipid

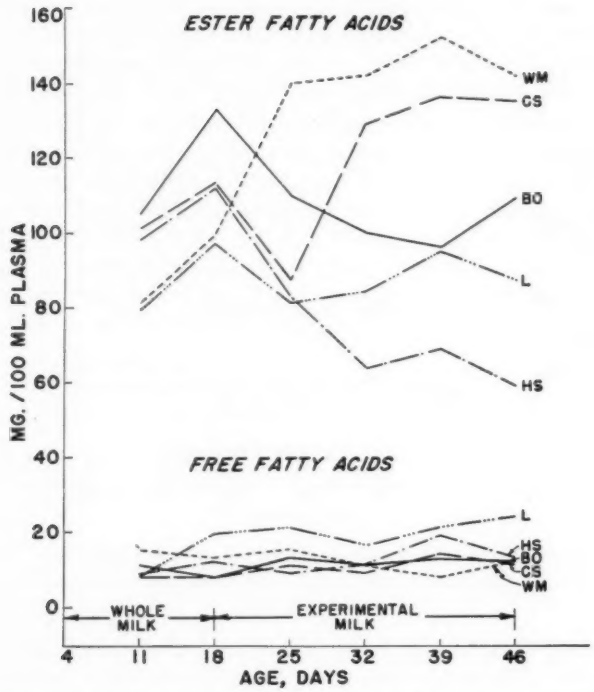

FIG. 4. Effect of dietary lipids on blood plasma ester and free fatty acids. (W M = whole milk, B O = butteroil, C S = crude soybean oil, H S = hydrogenated soybean oil, L = lard.)

percentage was lower during the experimental period. The ester cholesterol :total cholesterol ratios were similar to those reported earlier (24) for calves during early post-natal life and were not influenced appreciably by type of dietary lipid.

Milk intake was proportional to body weight except when digestive disturbances requiring feed reduction were encountered. During the 4-week experimental period no appreciable amount of scouring was noted except for calves fed crude soybean oil, among which diarrhea occurred frequently. Thus, the fat intake was at the approximate rate of 0.3 per cent of body weight daily with the exception of the crude soybean oil group, in which the intake averaged 0.26 per cent. Also, since the group mean initial weights did not vary greatly, the daily total fat ingestions of the various groups were similar except for the crude soybean oil group. Mean daily weight gains for the various groups during the 4-week period were relatively small (whole milk, 0.68 lb.; butteroil, 0.36 lb.; crude soybean oil, 0.40 lb.; hydrogenated soybean oil, 0.40 lb.; lard, 0.44 lb.) and apparently were not closely related to plasma lipid levels. Since the experimental period was comparatively short and since the number of animals per group was small, however, the significance of weight changes must be minimized.

TABLE 1

Summary of the comparative effects of the various dietaries on the blood plasma lipids

Dietary group	Period [a]	Plasma lipid							
		Total lipids	Ester fatty acids	Neutral fat	Ester cholesterol	Free cholesterol	Phospholipid	Free fatty acids	Allen fat
		(mg./100 ml. plasma) [b]							
I									
Milk fat (Whole milk)	Preliminary	198 ± 17	100 ± 12	44 ± 11	55 ± 7	18 ± 4	33 ± 5	13 ± 6	165 ± 15
	Experimental	285 ± 32	147 ± 14	50 ± 10	79 ± 7	23 ± 2	70 ± 25	10 ± 2	233 ± 18
II									
Milk fat (Butteroil)	Preliminary	252 ± 22	133 ± 8	57 ± 6	77 ± 9	18 ± 2	40 ± 10	8 ± 2	187 ± 19
	Experimental	199 ± 31	103 ± 20	48 ± 8	56 ± 7	16 ± 1	30 ± 12	12 ± 0.5	147 ± 20
III									
Crude soybean oil	Preliminary	215 ± 20	113 ± 18	45 ± 18	59 ± 6	18 ± 3	45 ± 5	8 ± 0.3	160 ± 16
	Experimental	267 ± 32	135 ± 20	57 ± 14	82 ± 11	22 ± 4	38 ± 4	13 ± 3	232 ± 19
IV									
Hydrogenated soybean oil	Preliminary	237 ± 18	112 ± 18	34 ± 20	78 ± 4	21 ± 3	40 ± 3	12 ± 7	196 ± 25
	Experimental	135 ± 9	64 ± 11	31 ± 13	39 ± 7	9 ± 1	14 ± 1	16 ± 6	102 ± 5
V									
Lard	Preliminary	203 ± 40	97 ± 23	34 ± 8	57 ± 13	15 ± 2	40 ± 13	19 ± 2	160 ± 38
	Experimental	196 ± 13	92 ± 9	32 ± 7	53 ± 3	16 ± 2	38 ± 1	22 ± 1	163 ± 10

[a] Preliminary values—1 sample from each calf, taken at the end of the preliminary whole milk feeding period. Experimental values—2 samples from each calf, taken at 3 and 4 wk. after change to the experimental diet.

[b] Each value is an av. for 3 calves (2 Holsteins and 1 Brown Swiss) ± standard error.

TABLE 2

Effect of dietary lipids on various plasma lipid interrelationships in young calves

Dietary group	Period [a]	Percentage of various lipids in total plasma lipids							Ester cholesterol: total cholesterol
		Ester fatty acids	Neutral fat	Ester cholesterol	Free cholesterol	Phospholipid	Free fatty acids	Allen fat	
I									
Milk fat (Whole milk)	Preliminary	50.6	22.3	27.6	8.8	16.4	6.4	83.4	75.7
	Experimental	51.6	17.5	27.8	8.2	24.4	3.6	81.8	77.5
II									
Milk fat (Butteroil)	Preliminary	52.7	22.7	30.6	7.3	15.9	3.0	74.2	80.7
	Experimental	51.7	24.5	27.8	8.2	14.7	6.6	74.2	77.3
III									
Crude soybean oil	Preliminary	52.4	21.0	27.5	8.2	21.0	3.9	74.0	76.9
	Experimental	50.7	21.4	30.7	8.2	18.1	4.8	86.6	79.0
IV									
Hydrogenated soybean oil	Preliminary	47.2	14.5	32.9	8.6	17.0	4.9	82.6	79.2
	Experimental	47.4	23.0	28.8	7.0	10.4	11.8	75.5	80.4
V									
Lard	Preliminary	47.8	16.6	27.9	7.3	19.9	9.6	78.8	79.0
	Experimental	46.6	16.3	27.1	7.9	19.4	11.3	83.0	77.3

[a] Preliminary—1 sample from each calf, taken at the end of the preliminary whole milk feeding period.
Experimental—2 samples from each calf, taken at 3 and 4 wk. after change to the experimental diet.

DISCUSSION

Previous work (24) has indicated marked early post-natal increases in the levels of total lipids, ester fatty acids, neutral fat, ester cholesterol and phospholipids of the blood plasma of dairy calves but no major changes in the levels of free cholesterol and free fatty acids. In the present investigation, although a different group of calves was employed, the results indicate that when no forages or concentrates (other than milk) are offered, whole milk feeding subsequent to the colostral period effects a continuation of these trends for a period of approximately 4 weeks.

The reason for the abrupt decline in most of the lipid values subsequent to change to feeding the various reconstituted milks, in sharp contrast to plasma lipid increases for calves fed whole milk, is not clear. Similar initial declines have been noted in Allen fat values for calves fed, subsequent to 4 days of age, reconstituted milks containing, respectively, butteroil, crude soybean oil, refined soybean oil, and hydrogenated soybean oil (5, 15). It is possible that this initial decline may be due to differences between whole milk and reconstituted milks in the quantity of phospholipids present and in the physical interrelationships between the phospholipids and the other lipids. The phospholipid content for whole milk fat was comparatively high (averaging 1 per cent), whereas the values for butteroil, hydrogenated soybean oil, and lard were low (approaching zero). Moreover, crude soybean oil, which resulted in less marked plasma lipid declines, contained a comparatively high, but variable, level of phospholipids (ranging from 0.1 to 4 per cent). Plasma lipid increases subsequent to the initial declines in calves fed reconstituted milks may result from physiological readjustments of the animal.

In the previous studies (5, 15, 22) when the change to experimental milk was made at 4 days of age the sharp decline in plasma fat after the initial week of reconstituted milk feeding was followed in the subsequent week by an increase, the magnitude of the reversal of trend depending upon the nature of the dietary lipid. In the present study, however, where the change to the reconstituted milks occurred at 18 days of age, this prompt reversal of the downward trend did not always occur. The cause for this differential response is not clear, but the variation may have been due to the difference in age at which the reconstituted milk feeding was initiated. The Allen fat values for calves fed whole milk, in the present study and in earlier work (22), displayed a much greater rate of increase during the age period from 11 to 25 days than was shown later; thus, there may be a strong tendency during the early period to effect this rise despite the nature of the dietary fat.

Results of the present investigation, which are in agreement with previous reports (5, 15), suggest that in most instances a period of approximately 3 weeks is required for maximum expression of dietary lipid effects. This conclusion is strengthened by the absence of significant changes in plasma lipid values in a preliminary study (23) in which butteroil, crude soybean oil, and hydrogenated soybean oil were fed to three dairy calves, employing a 3×3 Latin Square

design with each calf receiving each lipid for a period of 2 weeks. This period of time apparently was not adequate to permit maximum dietary effects.

The present data substantiate further the marked effect of type of dietary lipid upon the Allen fat values [which apparently include all the major plasma lipids except phospholipids and free fatty acids (2, 24)] in the blood plasma of young dairy calves and demonstrate that similar differences occur also in total lipids, phospholipids, ester fatty acids, and cholesterol (free and ester). The comparative uniformity among the various groups in the percentages of the various blood plasma lipid fractions (Table 2), however, suggests that the dietary lipids do not alter appreciably the relative proportions of the various plasma lipids observed. Moreover, the data confirm the opinion of others (16) that a balance among the various lipids is maintained and that this balance probably is more important than the absolute concentration of any one or all the lipids. In the current investigation the greatest deviations from this "balance" in lipid components were in the phospholipid and free fatty acid levels. In neither instance, however, was there a close relationship between the plasma level of the lipid and the apparent physiological well-being of the experimental animals.

It seems possible that the levels of the various plasma components may have been affected rather uniformly by one or more of several variable characteristics of the dietary lipids, including digestibility, melting point, presence of short chain fatty acids, total unsaturation, phospholipid content, and polyunsaturated fatty acid values. Differences in digestibility probably are not of primary importance, since limited data (22) indicate that the apparent digestibility of hydrogenated soybean oil (melting point approximately 39° C.), which resulted in the lowest values for most of the plasma lipids, is comparatively high (average, 92 per cent). Moreover, it has been demonstrated by Holmes and Deuel (11), in experiments with young men, that the coefficients of digestibility of hydrogenated peanut, cottonseed, and corn oils are not reduced appreciably until the melting point approaches 50° C. Similar results were obtained by Crockett and Deuel (7) in digestion studies with rats, using margarine, Crisco, and lard.

The observed quantitative variations in plasma lipids may have resulted, in part, from differences in the polyunsaturated fatty acid content of the dietary lipids. It has been proposed by Kartha (14) that the polyethenoid fatty acids of ingested lipids are preferentially converted to cholesterol esters and phospholipids in the lymph and, in contrast to the remainder of the lipid components, are not readily stored in adipose tissues. Other investigators have demonstrated selective conversion, in the blood, of polyunsaturated fatty acids to cholesterol esters (6, 8, 9) and to phospholipids (17, 18, 19, 20). Comparison of the plasma lipid values (Table 1) for the various dietary regimes with the polyunsaturated fatty acid contents of the ingested lipids (whole milk fat, 2.8 per cent; butteroil, 3.0 per cent; crude soybean oil, 54.1 per cent; hydrogenated soybean oil, 0.4 per cent; and lard, 10.8 per cent) demonstrate, however, that dietary polyunsaturated acid level is not the only factor involved.

It has been shown that dietary phospholipids increase the rate of absorption

of lipids in rats and man (1, 3, 21); thus, it is possible that a similar relationship may exist in the present data. Since the diurnal quantitative differences in blood plasma fat values among calves fed butteroil, crude soybean oil, and hydrogenated soybean oil are relatively uniform (4), however, the observed plasma lipid changes are not due primarily to differences in rate of absorption.

Total unsaturation and the presence of short chain fatty acids in the dietary lipids also may influence plasma lipid values, but neither would appear to be of primary importance in the present investigation. Moreover, the plasma lipid changes observed herein cannot be attributed solely to any one of the aforementioned dietary lipid characteristics. It is probable, therefore, that quantitative plasma lipid variations are the result of the interaction of a number of dietary and metabolic factors.

SUMMARY

Fifteen newborn calves were divided into five comparable groups and were allowed colostrum for 3 days. Subsequently, whole milk was fed for 2 weeks. During the following 4-week period one group continued to receive whole milk, whereas the other groups were fed reconstituted milks containing butteroil, crude soybean oil, hydrogenated soybean oil, and lard, respectively.

Weekly determinations of blood plasma lipids revealed major dietary effects. The values for total lipids, free cholesterol, ester cholesterol, ester fatty acids, and Allen fat were highest for the groups fed whole milk and crude soybean oil, lowest for the group fed hydrogenated soybean oil, and intermediate for the groups fed butteroil and lard. Trends in phospholipid values, although somewhat more variable, in general corresponded to those for total lipids. Changes in neutral fats and free fatty acids were not so marked. The relative proportions of the plasma lipid fractions observed were not altered markedly by the various dietaries. None of these plasma lipid components appeared to be closely related to dietary suitability of the various lipids employed in this study.

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EFFECT OF SPOILAGE BACTERIA ON BIACETYL CONTENT AND FLAVOR OF COTTAGE CHEESE [1]

R. B. PARKER AND P. R. ELLIKER
Oregon Agricultural Experiment Station, Corvallis

Observations on growth of certain cottage cheese spoilage bacteria indicated that their activity in the cheese usually was accompanied by loss of desirable butter culture aroma in the product. The bacterial species involved and the nature of the gelatinous or slimy spoilage defect have been described in an earlier paper (4).

Elliker and Horrall (3) observed that samples of butter contaminated with *Pseudomonas putrefaciens* displayed a marked loss of aroma during keeping quality tests. The reduction of aroma preceded the typical cheesy or putrid defect commonly associated with this organism. Chemical analyses correlated the loss of typical butter aroma with destruction of part of the biacetyl present. Later, Elliker (2) was able to demonstrate the ability of a number of types of bacteria to destroy biacetyl. The importance of the *Pseudomonas* group was emphasized in studies on commercial and experimental butters. It was pointed out that the loss of biacetyl due to microorganisms may be more important in some commercial foods than is generally realized.

In the present study, as in those on butter, the loss of proper aroma often was observed to precede the pronounced physical or flavor manifestations of the spoilage. Thus it seemed obvious that at least some strains of the spoilage organisms were destroying a major aroma component (probably biacetyl); consequently, further studies were suggested. Purposes of the investigation were to study the relationship of biacetyl to the desirable aromatic flavor of cottage cheese and to determine the effect of certain spoilage organisms on biacetyl content of cottage cheese, as well as on biacetyl added to milk.

EXPERIMENTAL

Analytical method. Analyses for biacetyl were conducted with a modified Pien, Baisse, and Martin method (1, 5) more recently described by Elliker (2). In general, the analytical method represented a colorimetric analysis of a steam-distilled fraction of the product. A further modification included in the present study involved generation of steam for the distillation in a 2-l. balloon flask holding a 20 ohm nichrome wire coil immersed in water. Steam flow was regulated by adjusting the voltage applied to the coil by means of a Variac transformer.

Fifty-g. portions of cottage cheese were acidified with 2 ml. of lactic acid which had been steamed previously to remove any traces of biacetyl. This mixture was carefully steam distilled and two 9-ml. portions of distillate collected

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in 15-ml. graduated centrifuge tubes containing 1 ml. of distilled water to cover the condenser tip. Steam flow was adjusted to allow about 10 minutes for each tube of distillate collected. One-half ml. of concentrated HCl and 0.1 ml. of a 2.5 per cent freshly prepared solution of orthodiaminobenzidine hydrochloride were added to each tube and the mixture allowed to stand for 15 minutes for color development. Color intensity was determined with a Beckman Model B spectrophotometer, using a wave length of 425 mμ. Pure biacetyl (Eastman) was used to construct a standard transmittance curve and a 1 p.p.m. solution of biacetyl was used as a reference standard with each set of determinations. Using this method, highly reproducible results were obtained from samples containing between 5 and 200 γ of biacetyl. Total acetylmethylcarbinol plus biacetyl was determined by refluxing the sample with 50 ml. of 40 per cent ferric chloride for 20 minutes in order to convert acetylmethylcarbinol to biacetyl and then proceeding as with biacetyl determinations. Acetylmethylcarbinol was determined by difference in the values. Because of high levels of acetylmethylcarbinol in cottage cheese, it usually was found necessary to make a 1 to 10 dilution of the distillate before addition of the HCl and color reagent in order to provide a final biacetyl concentration in the range of 5 to 200 γ.

Biacetyl content of commercial cottage cheeses. Thirty-eight commercial cottage cheese samples were obtained in as fresh a condition as possible from various sources. All cheeses were graded according to aromatic flavor as flat, moderate aroma, or high aroma, respectively. Also, included in the survey were six cheeses submitted to the Oregon Dairy Manufacturers' Association cottage cheese contest. In addition to the aromatic flavor grade, the six contest cheeses also received an average numerical flavor score from four experienced judges. After grading for flavor, representative portions of each of the 44 cheeses were analyzed for biacetyl and the results correlated.

Average flavor grades and biacetyl values of all samples are shown in Table 1. Simple inspection of the data in Table 1 indicates that there is a close correlation of desirable aromatic flavor with high biacetyl concentrations in cottage cheese. It is of interest that the numerical flavor score of the six contest cheeses ranged in almost direct relationship to the biacetyl content. In order of decreasing flavor score the cheeses contained 3.2, 2.4, 2.4, 1.8, 1.9, and 1.2 p.p.m. biacetyl, respectively. Cheeses with high acid or yeasty defects were not included in the

TABLE 1

Relationship of biacetyl content to flavor of 43 commercial cottage cheese samples

Flavor	Biacetyl content		
	Minimum	Maximum	Average
	p.p.m.	*p.p.m.*	*p.p.m.*
Flat aroma	0.15	0.62	0.41
Moderate aroma	0.62	1.40	1.05
High aroma	1.60	3.25	2.26

flavor data, although most cheese with acid defect had relatively high biacetyl concentrations.

Loss of biacetyl during keeping quality tests. About one-fourth of the graded samples were held at 10° C. for a keeping quality test. Biacetyl analyses were made at 0, 24, and 48 hours, and physical condition of the cheese was noted for an additional 5-day period. Representative results of biacetyl determinations during keeping quality tests are included in Figure 1. Although all samples included in Figure 1 were in satisfactory physical condition at the end of the initial 48-hour period, sample D displayed a typical gelatinous defect at the end of 96 hours. Samples A and C remained normal in physical appearance and aroma for the full 7-day period, whereas sample B developed a yeasty odor during the latter part of the keeping quality test. By culturing sample D on tryptone glucose milk agar and veal infusion agar containing 40 units of penicillin per milliliter, it was possible to isolate species resembling *Pseudomonas viscosa*. When these organisms were inoculated onto fresh uncontaminated cottage cheese curd, a typical gelatinous defect appeared within 64 hours.

Effect of pure cultures of three different species of spoilage bacteria on biacetyl content of cottage cheese. A fresh sample of uncontaminated cottage cheese was analyzed for biacetyl and then divided into 300-g. portions, three of which were inoculated respectively with 0.1 ml. of *P. viscosa*, *Pseudomonas fragi*, or *Alcaligenes metalcaligenes*. A fourth uninoculated portion was used as a con-

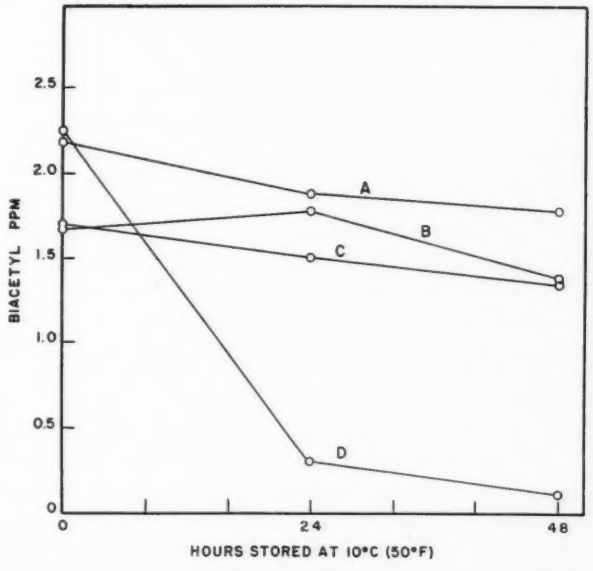

FIG. 1. Change in biacetyl content of four representative commercial cottage cheeses during keeping quality test. Samples A, B, and C are examples of cheeses with satisfactory keeping quality. Sample D developed a gelatinous defect within 96 hours.

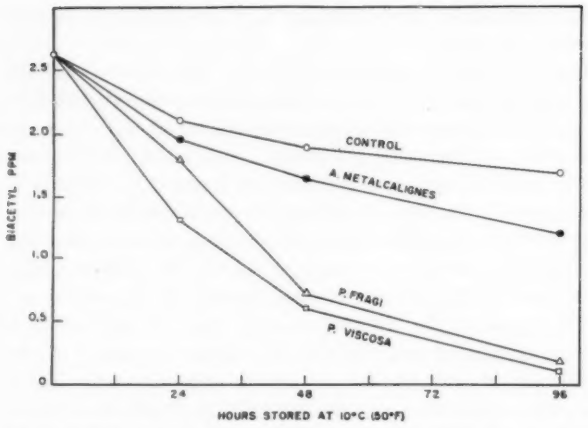

FIG. 2. Effect of growth of pure cultures of *P. viscosa*, *P. fragi* and *A. metalcaligenes*, on biacetyl content of cottage cheese.

trol. The samples were incubated at 10° C. and biacetyl analyses made at 24, 48, and 96 hours. Results of the study appear in Figure 2. At 24 and 48 hours all samples were in normal physical condition, although the portions inoculated with *Pseudomonas* species displayed an appreciable drop in biacetyl level at 48 hours. At 96 hours all samples inoculated with spoilage organisms displayed slight evidence of the typical gelatinous or slimy defect. At this time the uninoculated control remained in satisfactory physical condition and retained 1.7 p.p.m. of the 2.6 p.p.m. biacetyl originally present in the cheese. The sample inoculated with *A. metalcaligenes* showed slightly higher loss in that only 1.2 p.p.m. biacetyl was retained. This quantity, however, is appreciably larger than the 0.2 p.p.m. remaining in samples inoculated with *P. fragi* and *P. viscosa*.

Depletion of biacetyl by pure cultures in milk. In order to investigate the chemical path of the destruction of biacetyl, it was necessary to transfer studies to milk with added pure biacetyl because of the large quantities of acetylmethylcarbinol normally present in cottage cheese. Reconstituted nonfat milk made up to 10 per cent total solids was sterilized and adjusted to pH 5.2 to simulate pH conditions in cottage cheese, and sufficient biacetyl was added to provide 6 p.p.m. Analyses of the sterilized milk before addition of biacetyl indicated 0.8 p.p.m. acetylmethylcarbinol but biacetyl was not detected. Liter quantities of milk with the added 6 p.p.m. biacetyl were inoculated with 0.1 per cent of a 24-hour culture of *P. viscosa*, *P. fragi*, and *A. metalcaligenes*, respectively, and one uninoculated portion was retained as a control. Duplicate flasks were used for each organism. Withdrawal for analyses was made after 0-, 24-, and 54-hour incubation at 15° C.

As shown in Figure 3, the control demonstrated no loss or gain of either biacetyl or acetylmethylcarbinol at 24 hours. All inoculated flasks showed loss of biacetyl and corresponding gain of acetylmethylcarbinol indicating reduction of biacetyl to acetylmethylcarbinol. The milk inoculated with *P. fragi* showed a

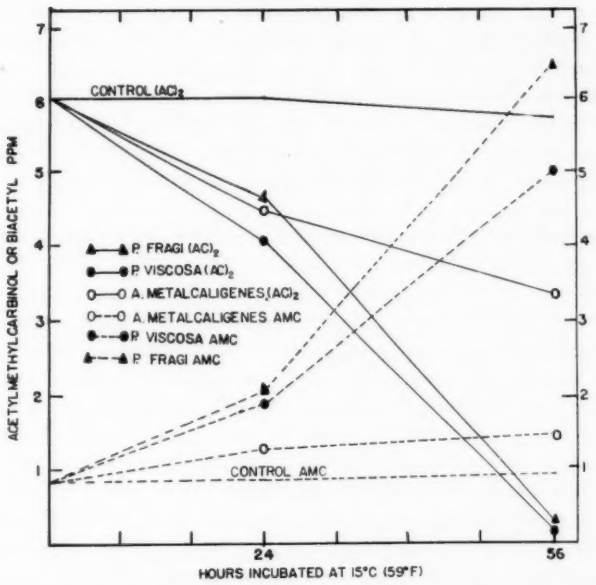

FIG. 3. Effect of growth of *P. viscosa*, *P. fragi* and *A. metalcaligenes*, respectively, on reduction of added biacetyl, $(AC)_2$, and consequent formation of acetylmethylcarbinol, AMC, in milk at pH 5.2.

1.3 p.p.m. loss of biacetyl and a gain of 1.2 p.p.m. of acetylmethylcarbinol, with 0.1 p.p.m. unaccounted for. The milk inoculated with *P. viscosa* showed a 1.9 p.p.m. loss of biacetyl and a 1.1 p.p.m. gain in acetylmethylcarbinol, leaving 0.8 p.p.m. unaccounted for. Milk inoculated with *A. metalcaligenes* showed a loss of 1.45 p.p.m. biacetyl and a gain of 0.5 p.p.m. acetylmethylcarbinol, leaving 1.0 p.p.m. not accounted for. At the end of 54 hours of incubation, the control sample displayed slight loss of biacetyl. Milks inoculated with either *Pseudomonas* species showed a loss of almost all biacetyl present, and in the case of *P. fragi* almost all biacetyl lost was accounted for in the gain in acetylmethylcarbinol value. The milk inoculated with *P. viscosa* contained 0.15 p.p.m. biacetyl and 5.1 p.p.m. acetylmethylcarbinol, which left 1.5 p.p.m. unaccounted for. *A. metalcaligenes* did not appear to be as active as the *Pseudomonas* species in the reduction of biacetyl; the portion lost was not accounted for as acetylmethylcarbinol and therefore may have been reduced to 2-3 butylene glycol or other compounds.

DISCUSSION

Undoubtedly a number of substances contribute to the proper flavor and aroma of cottage cheese. However, the intensity of the aroma contributed by biacetyl suggests that it is a primary agent. Also the lability of biacetyl would indicate one reason for wide differences in flavor of various cottage cheeses. The

importance of this compound to proper aromatic flavor is emphasized by the presence of high levels of biacetyl in cottage cheese with pleasing aroma and, conversely, lack of biacetyl in flat cheese. Also the destruction of biacetyl in cottage cheese results in loss of desirable aroma and a distinctly flat flavor.

Observations in these and other studies also have indicated that another important factor responsible for flat, unpalatable commercial cottage cheese is insufficient biacetyl production by the starter culture employed in its manufacture.

Several samples of commercial cottage cheeses were found to be extremely flat when first received. When incubated at 10° C. for 3 to 7 days, most of these samples developed gelatinous defects. Other samples were satisfactory when first tested but displayed marked loss of biacetyl during keeping quality tests. Invariably, such samples developed a typical gelatinous defect within 2 to 4 days after loss of the aroma compound. It should be pointed out that these conditions are more rigorous than would be found in most trade and household channels. However, there would appear to be ample time for the depletion of some, if not most, of the biacetyl during retail and household storage, provided the cheese was contaminated with *Pseudomonas* types. Such a cheese would be flat and unpalatable although succeeding stages of the defect were not apparent. In some instances it has been possible to predict subsequent spoilage by gelatinous or slime-producing organisms on the basis of abrupt loss of biacetyl during keeping quality tests.

Studies of the chemical nature of the depletion of biacetyl indicate that most of the compound is converted to acetylmethylcarbinol by *P. fragi* and slightly less by *P. viscosa*. Although *A. metalcaligenes* does not deplete biacetyl as rapidly as the *Pseudomonas* species, the portion that is affected is extensively reduced. This is emphasized by data which show that only about half of the reduced biacetyl is accounted for in the acetylmethylcarbinol fraction of the distillate. Presumably, a portion of the remaining biacetyl has been reduced to 2,3-butylene glycol.

SUMMARY

A simple, sensitive, and accurate method for determination of microquantities of biacetyl was applied in studies on the relationship of biacetyl to aromatic flavor of cottage cheese and the effect of gelatinous or slimy spoilage bacteria on aroma of cottage cheese.

Results indicated that the desirable aromatic flavor of cottage cheese is directly related to biacetyl content, and samples low in biacetyl were typically flat and less palatable.

Cultures of *P. viscosa* and *P. fragi* isolated from gelatinous cottage cheese were capable of rapidly reducing almost all biacetyl present in cottage cheese or in milk whereas a culture of *A. metalcaligenes* was much less active in such destruction. When *P. fragi* or *P. viscosa* were present, the complete loss of aroma preceded development of any apparent physical manifestation of spoilage.

Results demonstrated that the biacetyl involved is converted to acetylmethylcarbinol and some possibly to 2,3-butylene glycol.

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THE CHURNING TIME OF MILK FAT AT DIFFERENT TEMPERATURES

R. F. HOLLAND AND B. L. HERRINGTON
Department of Dairy Industry,
Cornell University,
Ithaca, New York

Information regarding the churning of cream and milk at various temperatures should serve as a guide in the control of the incipient churning of these products, which sometimes occurs during shipping and processing. Such information is reported in this paper.

Churning data have been reported by earlier workers. Storch (2) ran some determinations in which the temperature was closely controlled and which covered the range 8.8 - 30° C. However, he gives no information on the speed of the churn, acidity of the cream, or the melting point of the fat. Hittcher (1) studied churning times from 6 to 41° C. The temperatures were not maintained constant throughout the churning period, and the variation from beginning to end was often considerable. The cream used was low in fat content, most of it ranging between 12 and 14 per cent. Little data regarding the chemical and physical properties of the cream and fat were reported.

The following experiments were carried out to determine relative churning times under more accurately controlled conditions. "Time" was taken as soon as the "break" occurred. No attempt was made to obtain complete churning of the fat. For this reason, fat tests were not run on the buttermilk.

EXPERIMENTAL

An apparatus for churning was set up in a cabinet equipped with a heater and refrigeration coils for controlling the temperature over a wide range. A fan within the cabinet maintained a uniform temperature throughout. The motion of the churning machine was horizontal, and the samples to be churned were placed in 250-ml. sterilizer bottles, which were held in a horizontal position with the long axis of the bottle in the direction of the motion. The machine made 160 complete oscillations per minute and had a stroke of 6.5 cm.

Four series of experiments were performed. In each series the procedure was the same. One hundred and twenty-five ml. of the sample was placed in each of a series of bottles. These were stored for 3 days at 2 - 3° C., then were warmed to the churning temperature, held for 30 minutes, and agitated immediately. In some cases, duplicate samples were warmed to 45° C., then cooled to the churning temperature, held for 30 minutes, and agitated.

The results of these experiments are shown graphically in Figures 1, 2, 3, and 4, and the data for each are given in the corresponding Tables 1, 2, 3, and 4. The first set of data shows the behavior of sweet milk. The second deals with

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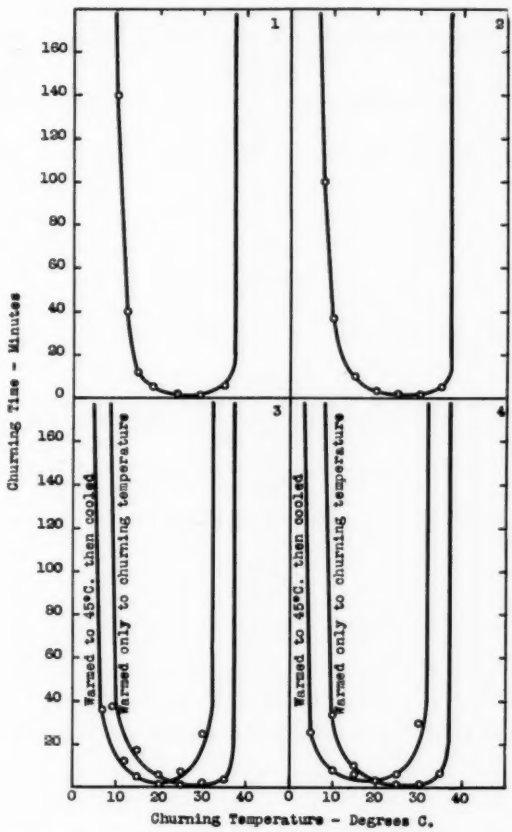

The time required to churn milk or cream at different temperatures: FIG. 1, sweet milk, 4.1% fat; FIG. 2, sour cream, 28% fat; FIG. 3, sweet cream, 23% fat; FIG. 4, sweet cream, 40.0% fat.

TABLE 1

A study of the time required to churn sweet milk[a] at different temperatures

Churning temperature	Churning time	Character of butter granules
(° C.)	*(min.)*	
10	40	shot like
12.8	40	shot like
15.5	12	popcorn
18.3	5	popcorn
24	1	soft
29.4	1/2	soft
35	6	oily
37.8	No churning in 3 hr.	

[a] Fat content, 4.1%; acidity, 0.17%; melting point of fat, 32.2° C. by the Wiley method.

TABLE 2

A study of the time required to churn sour cream [a] *at different temperatures*

Churning temperature	Churning time	Character of butter granules
(° C.)	*(min.)*	
8	100	shot like
10	37	shot like
15	10	popcorn
20	3	popcorn
25	2	soft
30	1.5	soft
35	5	very soft
40	No churning in 3 hr.	

[a] Fat content, 28.0%; acidity, 0.65%; melting point of fat, 32.2° C. by the Wiley method.

TABLE 3

A study of the time required to churn low test, sweet cream [a] *at different temperatures*

Churning temperature	Churning time	Character of butter granules
(° C.)	*(min.)*	
Part 1. Cream warmed to churning temperature, held 30 min., and churned		
6.5	81	shot like
9.5	38	shot like
15.0	18	popcorn
20.0	4	popcorn
25.0	2	soft
30.0	1.5	soft
35.0	4	oily
40.0	No churning in 3 hr.	
Part 2. Cream warmed to 45° C., then cooled to churning temperature, held 30 min. and churned		
7	35	shot like
12	12	popcorn
15	5.5	popcorn
20	3.5	slightly soft
25	7	soft
30	25	oily
35	No churning in 3 hr.	

[a] Fat content, 23.0%; acidity, 0.16%; melting point of fat, 32.4° C. by the Wiley method.

sour cream. The third and fourth show the behavior of sweet cream of low and high fat content, respectively.

For each table the churning times reported are the average of 10 trials at each temperature.

SUMMARY

These experiments indicate that for milk or cream having a fat content within the range 4.1 - 40.0 per cent there is little difference in the time required to churn at a given temperature.

Figures 3 and 4 illustrate the effect of the physical state of the fat upon the churning time. In both cases the curves were shifted to the left when the fat

TABLE 4

A study of the time required to churn high test sweet cream [a] *at different temperatures*

Churning temperature	Churning time	Character of butter granules
(° C.)	*(min.)*	
Part 1. Cream warmed to churning temperature, held 30 min., and churned		
5	No churning in 3 hr.	
10	34	shot like
15	10	shot like
20	3	popcorn
25	1.75	popcorn
30	2	soft; little buttermilk
35	6	very soft; little buttermilk
40	No churning in 3 hr.	
Part 2. Cream warmed to 45° C., then cooled to churning temperature, held 30 min., and churned		
5	25	shot like
10	8	popcorn
15	6	popcorn
20	3	firm
25	6	slightly soft
30	30	soft
35	No churning in 3 hr.	oily

[a] Fat content, 40.0%; acidity, 0.14%; melting point of fat, 32.2° C. by the Wiley method.

was completely melted by warming to 45° C. and then cooled to churning temperature and held for 30 minutes before shaking. Evidence is given also that there is an optimum relationship between the amounts of liquid and solid fat for churning to take place. If the amount of either is increased from this value, the churning time is lengthened. When the fat becomes totally liquid or totally solid there is no churning.

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THE INTAKE, DIGESTIBILITY, AND NUTRIENT DEFICIENCIES OF SEVEN SOUTHEASTERN HAYS

MARSHALL E. McCULLOUGH, D. M. BAIRD,
W. E. NEVILLE, JR., AND O. E. SELL
Georgia Experiment Station
Experiment, Georgia

Dairymen in the Piedmont region of the Southeast have a combination weather and feed requirement situation which is somewhat unusual in dairy cattle feeding. During the winter months pasture forage is extremely high in crude protein (20-30 per cent). The forage remains in a relatively immature stage of growth from about November 1 to April 1 and thus provides a feed that requires an energy supplement to provide a balanced ration. During the summer months, when the hay should be grown for winter feeding, the area has unfavorable weather conditions for the production of good quality hay. Hodgson (4) has summarized the problems encountered in making high quality hay in humid areas. Frequent rainfall during the months of favorable growing weather prevents the production of good hay by field-curing methods. The months when desirable curing weather is available are frequently too dry for plant growth. Thus, one of the greatest problems facing dairymen in this area is the production of roughages capable of furnishing relatively large proportions of available energy.

In an effort to determine the relative feeding value of hays most frequently fed in this area, six locally grown hays were purchased from growers within the area and used in a digestion trial. A seventh hay, coastal Bermuda, was included because it is a recent introduction by the Coastal Plain Experiment Station and promises a possible solution to the problem.

Deciding which of the many measures of nutritive value to use in securing such preliminary data is not easy. Feeding trials in which weight changes or milk production are used as criteria give no information as to the reason for such differences as may be found. Digestibility studies alone give no clue to the milk-producing ability of the forage under study unless wide differences are found.

Murray (6), in a highly theoretical paper, proposed the idea that the nutritive value of roughages could be resolved into two measurable factors—quantity and quality. He measured quantity as the total intake of gross energy and quality as the coefficient of availability of the organic matter. On this basis, he proposed that the nutritive value of a forage was a linear function of its digestibility. On the basis of our modern concept of a balanced ration, such a theory has some validity when two equally balanced rations are under consideration. Baker and coworkers (2) were unable to show any significant relationship between digestibility of the ration and efficiency of feed utilization by beef cattle.

It was concluded, therefore, that the use of digestibility studies to find the more prevalent deficiencies of the hays being fed, would be of value.

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EXPERIMENTAL PROCEDURE

Seven locally grown hays were purchased from growers. The hays used and their proximate chemical composition are shown in Table 1.

TABLE 1
The average composition of the seven hays (dry basis)

Forage	Crude protein	Ether extract	Crude fiber	NFE	Ash	Gross energy
	(%)	*(%)*	*(%)*	*(%)*	*(%)*	*(T / lb.)*
Crabgrass	6.66	2.69	32.54	54.40	3.70	2.00
Spanish peanut	9.61	2.85	43.61	37.00	6.94	2.01
Sericea lespedeza	11.34	2.32	42.63	40.34	3.36	2.23
Kobe lespedeza	13.00	1.94	38.65	43.38	3.02	2.00
Coastal Bermuda	14.66	2.37	28.39	50.90	4.26	1.96
Soybean	13.71	1.61	33.95	43.92	6.81	1.92
Runner peanut	12.36	2.50	34.18	44.67	6.30	1.82

Yearling Guernsey heifers weighing 750 lb. were used for the digestibility studies. Each period consisted of 14 days with no allowance made for change-over, since only hay was being fed. Chromic oxide was used as an indicator of digestibility and was fed at the rate of 15 g. per animal per day. The indicator was fed beginning the 7th day of each period and continuing through the 13th day. Fecal samples (grab method) were taken once daily during the 12th, 13th, and 14th day of each period and composited for analysis.

The crabgrass, sericea lespedeza, and Spanish peanut hays were fed in a 3×3 Latin square. The coastal Bermuda, soybean, runner peanut, and Kobe lespedeza hays were fed in a 4×4 Latin square.

Fecal samples were dried, ground, and analyzed according to the A.O.A.C. methods (1). Chromic oxide was determined by the techniques of Schurch *et al.* (7).

Table 2 shows the average U. S. hay grade which best characterized each hay according to the percentage of leafiness, color, and over-all quality. The hays were graded by a committee of three, using the specifications of the U.S.D.A. (8).

TABLE 2
Official U. S. standards met by each of the hays

Forage	U. S. standard met for		Grade given the hay
	Leafiness	Color	
Crabgrass	sample	sample	sample[a]
Spanish peanut	U. S. 2	U. S. 2	U. S. 2
Sericea lespedeza	U. S. 1	U. S. 3	sample[b]
Kobe lespedeza	U. S. 2	U. S. 2	U. S. 2
Coastal Bermuda	U. S. 1	U. S. 1	U. S. 1
Soybean	U. S. 2	U. S. 2	U. S. 2
Runner peanut	U. S. 1	U. S. 1	U. S. 1

[a] Badly weathered, seed heads formed, and 25% foreign material.
[b] 15% foreign material consisting of weeds, grass, and briars.

RESULTS AND DISCUSSION

The average digestibility of the dry matter, crude protein, ether extract, crude fiber, nitrogen-free extract, energy, and TDN are shown in Table 3.

TABLE 3
The average digestibility of the fractions and the average TDN content of the seven hays

Forage	Digestibility of						
	Dry matter	C. protein	E. extract	C. fiber	NFE	Energy	TDN
	(%)	*(%)*	*(%)*	*(%)*	*(%)*	*(%)*	*(%)*
Crabgrass	50.3	30.7	57.0	49.3	58.3	50.0	53.3
Spanish peanut	50.0	45.3	61.7	48.7	59.7	50.7	51.7
Sericea Lespedeza	47.0	35.0	53.7	55.3	46.7	49.7	49.0
Kobe Lespedeza	44.5	42.0	17.0	46.5	51.8	39.5	46.8
Coastal Bermuda	51.0	62.2	30.8	53.2	52.8	46.5	52.8
Soybean	48.8	64.2	22.0	36.2	58.0	45.5	47.2
Runner peanut	41.5	44.5	34.5	38.2	58.0	41.0	46.5
Correlation with dry matter digestibility		0.23	0.38	0.45	0.13	0.77[a]	0.83[b]

[a] Significant at the 5% level.
[b] Significant at the 1% level.

TABLE 4
Average intake and performance of the heifers on each hay in relation to the nutrients supplied

Forage	Av. weight	Average daily intake				Av. daily change in body weight
		D. M.	Dig. P.	Dig. D. M.	TDN	
	(lb.)	*(lb.)*	*(lb.)*	*(lb.)*	*(lb.)*	
Crabgrass	810	15.4	0.44	7.75	7.75	+ 0.89
Spanish peanut	810	15.9	0.70	7.95	8.22	+ 1.64
Sericea Lespedeza	810	16.5	0.65	7.75	8.08	— 0.07
Kobe Lespedeza	683	13.6	0.74	6.05	6.36	+ 0.01
Coastal Bermuda	683	13.2	1.20	6.73	6.96	+ 0.45
Soybean	683	13.4	1.18	6.54	6.32	+ 0.50
Runner peanut	683	13.6	0.74	5.64	6.28	+ 0.87

The average body weight of the animals used, their average daily intake of dry matter, digestible protein, digestible dry matter, TDN, and average daily change in body weight are shown in Table 4. The animals were fed sufficient hay to permit weighbacks, but they failed to consume enough dry matter to meet the recommended allowances for animals of their size. All of the hays failed to provide adequate quantities of TDN largely because of low digestibilities. In general, the hays most nearly provided adequate quantities of digestible protein, and two hays (coastal Bermuda and soybean) provided an excess of protein. The ability of each hay to supply digestible protein and TDN in relation to Morrison's standards (5) is shown in Figure 1. The average weight changes indicate that the hays all provided about a maintenance ration. It is of interest to note that there was little real relationship between the hay grades and the digestibility or weight changes of the animals. The three legume hays, Spanish peanut, runner peanut, and soybean, undoubtedly reflected their high

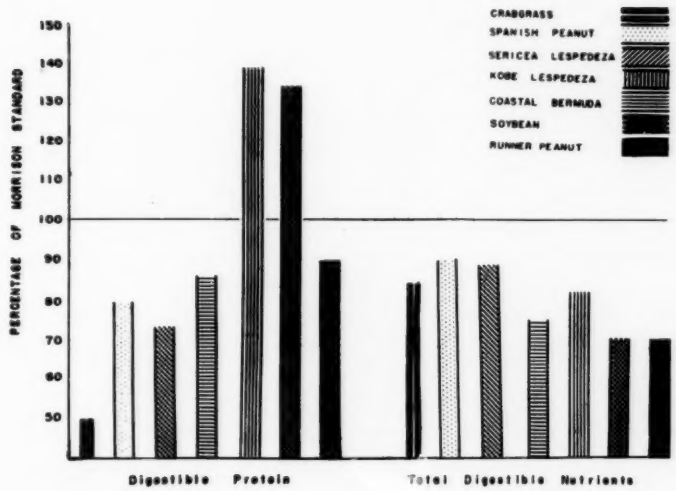

FIG. 1. The relative ability of each hay to supply the recommended allowances of protein and TDN when fed free choice.

leaf ratings. The grass hays performed independently of their ratings, and the two lespedezas graded much higher than their feeding value, suggesting that additional research is needed on lespedeza hays. In physical appearance, lespedezas frequently appear much higher in quality than their subsequent feeding value. Undoubtedly, there are many complex carbohydrates, and perhaps a detrimental lignin complex, in these hays which prevent satisfactory digestion of the energy fractions.

If the samples of hay included in this study are typical of those being used by a majority of dairymen in this area, then the most obvious need for improvement is in the TDN. Research by Dawson *et al.* (3) supports the premise that improved methods of hay making in this area would both improve the TDN of the hay and increase the crude protein.

The TDN of the hays was approximately the same as that usually listed for average alfalfa hay and would be considered as suitable hay for many feeding conditions. Since the specific need in a dairy program is for hays that will supply an abundant source of energy, the hays were probably 5 to 10 per cent too low in TDN.

Finally, it was of interest to note (Table 3) the high correlation between the TDN value, the digestible energy, and digestible dry matter ($r = 0.77$ and 0.83, respectively). As a measure of the digestibility of the energy components of a hay, little was gained from determining separate fractions other than dry matter and crude protein. This relationship would be expected in forages because the ether extract is small. The correction for that present may be of questionable value since it is of indefinite composition.

SUMMARY

Six hays in popular use in the Piedmont region and one new hay recently developed for the climatic and soil conditions in the area were used in digestibility studies with 750-lb. Guernsey heifers. The object was to determine the gross nutrient deficiencies of these roughages. The greatest need for improvement was found to be in the TDN content of the forages. Five of the hays were deficient in digestible crude protein, but it is suggested that improving the TDN content will adequately improve the crude protein content.

ACKNOWLEDGMENT

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THE ESSENTIAL AMINO ACID CONTENT OF THE PROTEINS ISOLATED FROM MILK OF THE COW, EWE, SOW, AND MARE [1]

B. C. RAY SARKAR,[2] ALICE J. RYKALA, AND C. W. DUNCAN
Department of Agricultural Chemistry,
Michigan State College,
East Lansing

With the recognition of the dietary indispensability of certain amino acids, the determination of the amino acid content of milk proteins has assumed unusual importance. For obvious reasons, principal attention has been given to the study of the chemical composition of bovine milk, whereas in other species of mammals attention has been directed toward the determination of total solids, fat, total protein, milk sugar, and ash (3, 4, 10, 11, 12, 13). Some systematic work has been done on the component fatty acids of milk fat from a few species of animals (10), but, with the exception of the cow, there is only fragmentary information concerning the amino acid composition of the milk proteins of domestic animals. Recently, work has been reported on the nitrogen distribution (18) and the vitamin content of colostrum and milk of the sow (6, 9, 15).

In view of the paucity of information concerning the amino acid content of proteins of milk from some of the common species of mammals, a study was initiated to determine the essential amino acid content of the mixed proteins isolated from milk of the cow, ewe, sow, and mare.

EXPERIMENTAL

Samples of milk were obtained from six Holstein cows, twelve ewes (four each of the Shropshire, Rambouillet, and Hampshire breeds), six sows, and three mares. The cows were in various stages of lactation, whereas milk from the other mammals was obtained from 1 to 2 weeks postpartum.

The samples of milk from each species or breed were pooled and thoroughly mixed. The protein in a 100-ml. aliquot of milk was isolated by precipitation with an excess of 50-per cent trichloroacetic acid at 2° C. for 24 hours, according to the method outlined by Block and Bolling (2). The precipitate was washed thoroughly with cold 10-per cent trichloroacetic acid, and the excess acid and lipids were removed by successive extraction with acetone, hot alcohol, hot benzene, and ether. The white powdery precipitate was dried at 105° C. to constant weight, and the final product was analyzed for nitrogen by the macro Kjeldahl method. The factor of 6.38 was used to convert nitrogen to protein.

Preparation of the protein hydrolyzates was based on procedures reported previously (17). The quantity of protein used for hydrolysis varied from 0.1

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[2] Present adress: Defense Science Organization, New Delhi, India.

to 0.2 g. and the volume of hydrolyzate was made up to 100 ml. The assays were run after the proper dilutions had been made. DL-configurations of isoleucine, leucine, methionine, phenylalanine, threonine, and valine were used in the preparation of standards for these amino acids, whereas the L-configurations were used for the preparation of the arginine, histidine, lysine, and tryptophan standards.

For the assay of the various amino acids, 5-ml. portions of the appropriate basal medium, free of the amino acid to be assayed, were placed in lipless culture test-tubes. A standard curve of eleven levels was prepared by adding in triplicate, amounts ranging from 0 to 5 ml. of the standard amino acid solution to separate tubes of medium. The protein hydrolyzates were added in duplicate in 1.0-, 2.0-, and 3.0-ml. quantities of the proper dilution to another set of tubes containing 5 ml. of the particular amino acid-free medium. The total volume was brought to 10 ml. in all tubes. The tubes were capped and sterilized by autoclaving at 15 lb. pressure for 10 minutes. Each tube was inoculated aseptically with one drop of the appropriate organism suspension and then incubated for 72 hours at 37° C. After incubation, the acid in each tube was titrated electrometrically with 0.1 *N* NaOH to pH 7.0. The reliability and reproducibility of the various amino acid determinations have been reported (17).

RESULTS AND DISCUSSION

The data obtained for the amino acid content of the proteins isolated from the milk of four species of mammals are presented in Table 1, together with comparable data taken from the literature on whole milk. The amino acids isolated from the proteins of milk from cows and ewes, appear to have similar concentrations. With the exception of a higher arginine value, the composition

TABLE 1

Essential amino acids in the mixed proteins isolated from the milk of the cow, ewe, sow, and mare

(All values expressed as a per cent of the crude protein on the moisture- and fat-free basis)

Amino acid	Cow			Ewe		Sow		Mare
	Milk (8, 17)[a]		Protein	Milk (14)	Protein	Milk (1)	Protein	Protein
	J[b]	H						
Arginine	4.00	3.92	4.31	3.26	4.43	5.76	5.57	6.78
Histidine	2.95	2.59	2.69	2.80	2.87	2.19	2.70	3.01
Isoleucine	6.84	6.77	6.00	5.60	6.67	4.26	5.78	6.87
Leucine	9.93	9.22	8.63	9.80	9.27	8.09	8.14	9.26
Lysine	7.57	7.88	7.41	8.61	7.45	7.37	6.79	6.79
Methionine	2.11	2.25	2.20	2.58	2.58	1.37	1.97	2.11
Phenylalanine	4.82	4.67	4.97	4.75	5.24	3.50	4.63	5.04
Threonine	4.73	4.46	5.47	4.42	5.04	3.63	5.00	4.67
Tryptophan	1.57	1.38	1.53	.....	1.46	.....	1.26	1.29
Valine	7.34	7.43	7.09	7.54	7.66	5.07	6.11	7.91
Protein *(%)*	3.52	2.78	91.72	4.71	91.60	5.73	92.79	92.43
No. of animals	20	6	6	4	12	2	6	3
No. of detn.	20	6	1	11	3	18	1	1

[a] Number in parentheses refer to the number of the reference cited.

[b] J and H refer to Jersey and Holstein breeds.

of the protein isolated from mare's milk is similar to that of cow's and ewe's milk. The isolated protein from sow's milk appears to contain less leucine, tryptophan, and valine than that from the three other species, but more arginine than the proteins from the cow or ewe and less than that in the proteins from the mare. The isolated milk proteins from sow's and mare's milk contain more arginine and possibly less tryptophan than are found in the milk of the two ruminants, whereas the proteins from cow's milk may contain more threonine than the proteins from milk of the three other species. In general, the differences noted above may not have any real significance. This observation seems to be justified from the data published recently on the amino acid content of milk from individual cows (8). The small number of animals used in this work and the experimental procedures involved in the isolation and preparation of proteins and in the assay technique also may be contributory.

The agreement between the amino acid content of the mixed proteins isolated from milk and that reported for whole milk is satisfactory, except that there appears to be more threonine in the isolated protein. The amino acid values obtained for the isolated proteins from ewe's milk agree very well with those reported by Kuiken and Pearson (14) for ewe's milk, with the apparent exception of the arginine content of the isolated protein. The concentrations of histidine, isoleucine, methionine, phenylalanine, and threonine in sow's milk published by Beacom and Bowland (1) are less than those found in the isolated protein. The data included in Table 1 for sow's milk were the average of 18 determinations from two sows and one determination on the composite isolated proteins from six sows. The difference noted above for sow's milk and proteins can only be reconciled when similar data from more sows become available. Data concerning the amino acid composition of milk from the mare do not appear in the literature, insofar as the authors are aware.

From the above results, the nutritive value of milk protein from the different species included in this investigation would not be expected to vary appreciably. Braude *et al.* (5) reported the biological value and digestibility of the proteins of milk from the cow and ewe to be 85.1 and 93.2 and 90.3 and 95.2, respectively.

Table 2 presents the data on the essential amino acid content of the isolated proteins from the milk of three breeds of ewes. These data are a breakdown of the composite data included in Table 1. Practically no breed difference is noted. In this respect the results agree with the findings of Kuiken and Pearson (14), who determined the essential amino acid (except tryptophan) content of milk from four breeds, three of which were different from those included in this work.

Although both protein and fat are composed of simpler units of amino acids and fatty acids, respectively, the similarity of the amino acid pattern of the mammalian milk proteins reported in this investigation is in contrast to the dissimilarity in the fatty acid components of milk fat from different species of mammals. These data have been compiled from the literature and are presented in Table 3. The reason why the amino acid components of milk protein from the cow, ewe, sow, and mare are so similar and the fatty acid components of milk

TABLE 2

Essential amino acid content of the mixed proteins isolated from the milk of three different breeds of ewes

(All values expressed as a per cent of the protein on the moisture- and fat-free basis)

Amino acid	Shropshire	Rambouillet	Hampshire	Range of values[a]
Arginine	4.41	4.24	4.64	3.05-3.48
Histidine	2.79	2.88	2.94	2.70-3.03
Isoleucine	6.67	6.49	6.86	5.39-6.02
Leucine	9.37	9.20	9.25	9.46-10.41
Lysine	7.39	7.39	7.58	8.11-9.11
Methionine	2.61	2.46	2.66	2.37-2.69
Phenylalanine	5.32	5.17	5.23	4.61-5.12
Threonine	5.25	5.00	4.88	4.25-4.63
Tryptophan	1.40	1.40	1.57	.....
Valine	7.52	7.96	7.51	6.93-8.16
Protein (%)	89.93	93.88	91.00	4.35-5.21

[a] Data from Kuiken and Pearson (14). Breeds: DeLaine Merino, Dorset, Rambouillet, and Suffolk.

TABLE 3

Component fatty acids of milk fat from the cow, ewe, goat, sow, mare, and human

(Grams per 100 g. of milk fat)

Constituent	Cow (16)[a]	Ewe (12)	Goat (16)	Sow (7)	Mare (12)	Human (16)
			Saturated fatty acids			
Butyric acid	3.1	2.8	2.6	.....	0.4	0.4
Caproic acid	1.0	2.6	2.3	.....	0.9	0.1
Caprylic acid	1.2	2.2	2.7	1.3	2.6	0.3
Capric acid	2.6	4.8	8.4	.....	5.5	1.7
Lauric acid	2.2	3.9	4.5	.....	5.6	5.8
Myristic acid	10.5	9.7	11.1	1.5	7.0	8.6
Palmitic acid	26.3	23.9	28.9	26.9	16.1	22.6
Stearic acid	13.2	12.6	7.8	6.5	2.9	7.7
as Arachidic acid	1.2	1.1	0.4	.....	0.3	1.0
			Unsaturated fatty acids			
Decenoic acid	0.2	0.1	0.2	.....	0.9	0.1
Dodecenoic acid	0.2	0.1	0.3	.....	1.0	0.1
Tetradecenoic acid	1.1	0.6	0.5	.....	1.8	0.6
Hexadecenoic acid	3.1	2.2	2.5	8.3	7.5	2.9
Oleic acid	32.2	26.3	27.0	36.7	42.4	36.4
Linoleic acid	2.8	5.2	2.6	14.6		8.3
Linolenic acid	.....	.....	.....	.....	.....	0.4
as C_{20-22} acid	1.0	1.9	0.4	4.2	5.1	4.2
Arachidonic acid	1.0	.....	1.5	.....	.....	0.8

[a] Numbers in parentheses refer to the number of the reference cited.

fat are so different may be sought in a study of the mammary mechanism of each species for synthesizing these two complex compounds.

SUMMARY

Mixed proteins isolated from the milk of the cow, ewe, sow, and mare have been assayed for the essential amino acids by microbiological methods. In general, the concentration of the amino acids in the proteins from the different species is similar, although higher concentrations of arginine and lower con-

centrations of tryptophan may be present in the milk proteins of the sow and mare than are present in the proteins of the cow and ewe.

There appeared to be no difference between the amino acid content of the proteins isolated from the milk of the Shropshire, Rambouillet, and Hampshire breeds of ewes.

Species difference in the amino acid components of mammalian milk proteins is not as spectacular as it is in the fatty acids components of milk fat, although the protein molecules are more complex than fat molecules.

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CUT ALONG THIS DOTTED LINE

CUT ALONG THIS DOTTED LINE

ERRATA

The article entitled "Cultural Methods and Some Characteristics of Some of the More Numerous Groups of Bacteria in the Bovine Rumen," by M. P. Bryant and L. A. Burkey, which appeared in the March, 1953, JOURNAL OF DAIRY SCIENCE, pages 205-217, included two tables which contained inadvertent errors. Tables 1 and 2 below are correct, and should replace original Tables 1 and 2 in the regular March issue. Please cut them out and paste them over the ones now appearing on pages 209 and 213 of your copy of the March JOURNAL.

TABLE 1

Characteristics of some different groups of anaerobic bacteria isolated from the rumen

Group designation	Motility	Gram reaction	H_2S	Gelatin liquefaction	Acid from			Hydrolysis of	
					glucose	d-xylose	cellobiose	starch	cellulose
CeC	—	+	—	—	±	±	+	—	+
CeR	—	—	—	—	+	—	+	—	+
+C—S	—	+	—	—	w[a]	—	—	+	—
R—GXCS	—	—	—	±	+	+	+	+	—
±CR—GXC	—	v[b]	—	—	+	±	+	—	—
CR—S	—	—	—	—	—	—	—	+	—
+SR—gGXC	—	+	—	+	+	+	+	—	—
MR—GXCS	+	—	—	±	+	+	+	+	—
MR—GXC	+	—	—	—	+	+	+	—	—
SR	—	—	w	±	w	w	w	—	—
MOR—GS	+	—	—	—	+	—	—	+	—
S—GX	+	—	—	—	+	+	—	—	—
Spirochetes	+	—	—	±	+	±	+	—	—

[a] w = weak reaction or negative.
[b] v = Gram variable.

TABLE 2

A comparison of growth of certain kinds of rumen bacteria in glucose or cellobiose media with varying amounts of sodium carbonate.

No. strains studied	Designation of culture	No Na_2CO_3		0.02% Na_2CO_3		0.05% Na_2CO_3		0.1% Na_2CO_3		0.4% Na_2CO_3[a]	
		pH	growth	pH	growth	pH	growth	pH	growth	pH	growth
4	CeC	6.5[b]	—[c]	6.4	—	6.0	++	5.8	++	5.7	+++
3	+C—S	6.5	—	6.4	—	6.4	+	6.5	+	6.4	+
4	R—GXCS	6.5	—	5.65	+++	5.4	+++	5.4	+++	5.8	+++
2	±CR—GXC	6.2	—	5.7	—	5.4	++	5.3	++	5.9	+++
2	+SR—gGXC	6.5	—	5.2	++	5.1	++	5.1	++	6.0	+++
4	MR—GXCS	5.3	+++	5.3	+++	5.2	+++	5.2	+++	5.8	+++
4	MR—GXC	5.1	+++	5.1	+++	5.1	+++	5.1	+++	5.9	+++
1	MOR—GS	6.5	—	6.5	—	6.3	—	6.0	+	5.5	++
2	S—GX	6.5	—	6.2	+	6.0	+	5.7	++	5.7	+++
3	Spirochetes	6.5	—	6.4	—	5.9	—	5.6	+	5.5	++

[a] The medium containing 0.4% Na_2CO_3 was prepared with carbon dioxide gas and is not comparable to the other media because of its high buffer capacity.
[b] Averages of values obtained on the strains studied.
[c] — = no visible growth
+ = slight amount of visible growth
++ = moderate amount of visible growth
+++ = large amount of visible growth

PROCEEDINGS OF THE FORTY-EIGHTH ANNUAL MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION

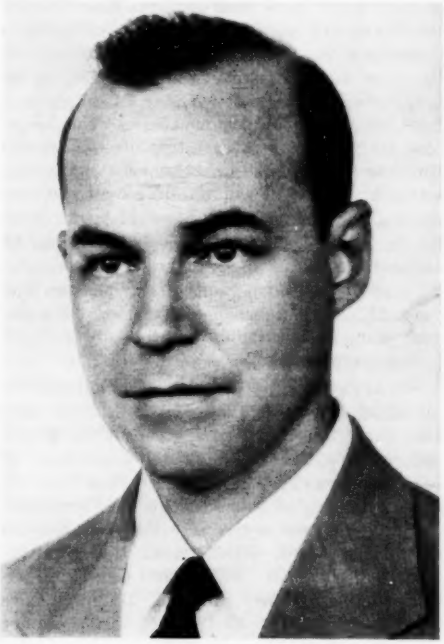
P. R. ELLSWORTH, Secretary-Treasurer

The American Dairy Science Association met for its opening session in the Theatre, Wisconsin Union Building, University of Wisconsin, Madison, at 9:45 A.M. on June 22, 1953. Following the singing of the National Anthem, the invocation, and an address of welcome by Dr. E. B. Fred, President of the University of Wisconsin, H. C. Jackson, presiding officer, introduced President H. B. Henderson, who gave the following address:

THE PRESIDENT'S ADDRESS

Dr. Jackson, members of The American Dairy Science Association, Distinguished Guests, Ladies and Gentlemen:

I wish it were possible for me to formulate, in a concise statement the individual expressions of appreciation on the part of our members for this opportunity to come to Wisconsin, "The Dairyland of America." There are many reasons why we welcome this opportunity. To some, it is merely the routine attendance at the annual meeting of our Association. They would be present wherever the meeting might be held, because they are that loyal to the organization. To many of our younger members it may be the first opportunity to come to Wisconsin to visit the State and University of which they have heard so much. To some it is the opportunity to come back home for a visit, because this University has probably contributed as many college trained employees to the dairy industry of America as any other institution. You will note that I have qualified that statement with the word "probably"; I am pleased with the harmony which exists within our Association, and I have no desire to create a controversy here during the last days of my term of office. So you see there are many reasons why we are happy for the privilege of coming to Wisconsin for this, the 48th annual meeting of the American Dairy Science Association. I believe the Association has met at this institution only one other time, that being on June 26, 1928. We hope it will not be twenty-five years before we again meet on the campus of this great University. I believe it would be appropriate for me to quote a few excerpts from the proceedings of that historic meeting.



H. B. HENDERSON

". . . The meeting began at 9:15 on June 26 with Professor H. C. Jackson presiding . . . It was fitting that Professor Jackson should have presided at this meeting and that Dean H. L. Russell should have presented the opening remarks since the first dairy school in America was held at the University of Wisconsin for the purpose of giving instruction in the Babcock test . . . The meeting was unusual on account of the absence of the executive committee . . . On the evening of the same day, a banquet was planned at the Park Hotel for 6:30. The real feature of the banquet was the presence of Dr. S. M. Babcock, Emeritus Professor of the University and originator of the test for fat in milk and

cream which bears his name . . . The dairy manufacturers section held its meeting . . . with W. V. Price of New York presiding."

The dairy industry of the entire world owes much to the University of Wisconsin. The scientific contributions of the faculty and students of this institution have been far reaching in their influence on the continuous progress of the dairy industry during the past century. To enumerate those contributions would require more time than has been allotted for the entire meeting. Certainly in the few minutes at my disposal I will not attempt to list even the ones we commonly think of as being of major importance. Let us simply say, President Fred, that the members of the American Dairy Science Association, as well as the workers throughout our great dairy industry, are grateful for the outstanding contributions of this University. We have just employed one of your recent graduates as a member of our dairy staff at the University of Georgia. So even in the deep South we recognize that "you all" have a great institution. (I knew you would be disappointed if I did not get that in some place.)

We are grateful to the local committees for arranging the many details which have been necessary for this meeting. Relatively few people have had the personal experience of being responsible for arrangements for an annual meeting of this Association. They alone are able to fully appreciate the vast amount of work required. I understand that registration this year will surpass that of any previous meeting of the American Dairy Science Association, in spite of the fact that there are several conflicts, including the World's Dairy Congress, at which a large number of our members are in attendance. I hope each of you will personally express your appreciation to Dr. Weckel, chairman of the local arrangements committee and his associates for the many courtesies being extended to us.

I feel it is my duty and responsibility as your president to tell you about some of the activities of the Association during the past year. Perhaps this could be done at the time of the business meeting on Wednesday morning, but I think you may be in better position to conduct the business of the Association with these few advance remarks.

Much of the work of the Association is conducted through committees, and at this time I want to pay tribute to those people who have worked so tirelessly on the assignments given them. I have wondered whether I was merely fortunate in the selection of the people I asked to serve on the committees, or whether the membership of the Association is so loyal that anyone I might have chosen would have done the same splendid work. At any rate, I am sure the committees this year have been the best that could have been selected for the various assignments. Also, I want to express my appreciation to the members of the Executive Board and the officers of the various sections for their assistance and cooperation. They are a grand group with which to work.

We had some new committees this year, the work of which has been exceedingly important. For example, we have had a committee on membership promotion which in addition to revising the promotional literature, has sponsored a membership campaign that has resulted in a significant increase in our membership. At the present time our membership is approximately 1,675, an increase of about 160 over the peak reached in 1952. It was through the efforts of this committee that local membership committees were established in each state and in Canada. Some of these committees have been very active, as evidenced by the substantially increased membership in their states. It is my hope that this membership campaign will not subside. If each of us will do a selling job among our associates, the regular membership should reach the 2,000 mark before the end of 1953. The membership committee was also responsible for the operation of a booth at the Dairy Industries Exposition in Chicago last fall, which resulted in a number of new members and some excellent publicity for the Association.

We have had a committee this year making a study of the Association's management and operation as well as outlining a public relations program. Members of this committee have made many personal sacrifices in an effort to carry out the assignment given the committee last year by the Executive Board. It is difficult to imagine a group of men more serious minded and determined to do a thorough job of their assignment than those appointed to this committee. You will be interested in the detailed report of this committee at the time of the business meeting on Wednesday.

Although the Dairy Curricula Committee is not a new one this year, I mention it specifically because the members of the committee hope their work has been concluded. The recommendations of this committee will have far reaching influence on the dairy curricula of our colleges in the years to come. I am sure that we agree that this committee has made a

thorough study of the problem of the dairy curricula under present conditions. I believe a detailed report of this committee has been sent to each institution, and I hope most of you have had an opportunity to study it.

With reference to the awards committees, perhaps I should say that a change has been made in the procedure of announcing the award winners. For the first time since our award program was initiated several years ago, the recipients of the awards have been notified that they are expected to be here and to be present at the awards program tomorrow evening. It was felt that this would relieve the Secretary of a considerable amount of work and worry in devising ways and means to have the honored individuals present. Also, it appears that the sudden shock of being announced as the winner of one of the awards was considered as possibly being too great for some of our hard working dairy scientists.

The work-horse committee of the Association each year is the Journal Management Committee. Inasmuch as the major portion of our finances is used in publishing the *Journal of Dairy Science,* this may be considered our most important committee. Under the able leadership of our Vice-President, Dr. Walter V. Price, this committee has shouldered tremendous responsibility during the past year. Faced with the loss of our Editor, Dr. F. E. Nelson, within a few months after the 1952 annual meeting, the committee proceeded in a most business like manner in securing the services of one of America's foremost dairy scientists and a man with much editorial experience, Dr. Paul H. Tracy. I can assure you that it was with a shout of joy and a sigh of relief that the Executive Board unanimously approved the recommendation that Dr. Tracy be employed as Editor of the Journal. On behalf of the Journal Management Committee, as well as the Executive Board, I want to express appreciation for your courtesy in voicing your opinion on some of the problems of our Association with which this committee is so concerned. I want to assure you that the committee approached the problems involved in their assignment this year in the hope that its final decisions would be for the best interests of the entire membership as well as the dairy industry generally.

I wish time would permit me to tell you something of the work of our other committees, including the committees within the sections, and even the work of the section officers. This, of course, will not be possible, but I must say a word in behalf of our program committee. I am sure no previous program committee has had more difficult decisions to make concerning the program than the one this year. With interest in many phases of the dairy industry, it seemed appropriate to include a number of symposia. Which topics to include and which to leave out was not an easy decision. Then came the call for papers, and the response was far greater than the committee had ever dreamed was possible. So far as I have been able to determine, the number of papers to be presented at this meeting is the largest number ever included in a similar program.

A word about the financial picture of our Association might be in order at this time. Although our Secretary, Mr. P. R. Ellsworth, will present his report in detail at the business session on Wednesday, I would like to say that on the basis of our present program, the financial picture is good. By this I do not wish to lead you to believe that I am satisfied, or that the Executive Board is satisfied, with the job we have been able to do during the past year. Among other things, I feel that our Association must develop a much stronger public relations program, and such a program cannot be financed on the basis of our present income. For example, there are many meetings of national and international importance at which the prestige of our Association should be recognized through the presence of a capable representative, or representatives. Your president can travel very little on the allocation provided him for that purpose during the year, and not many institutions are in position to underwrite the expenses necessary for him to do the job he would like to see done. Likewise, your Secretary with his meager travel allocation and your Editor with his even more meager allowance are helpless as far as travel on behalf of the Association is concerned.

This paves the way for a few additional remarks which I would like to make. In the presidential address of Dr. G. M. Trout at the 1950 meeting this statement was included: "The dairy industry is confronted today with many problems from which the American Dairy Science Association and its individual members cannot entirely wash their hands." I want to say that the problems to which Dr. Trout referred have not been solved. They are still with us today.

One of the problems mentioned by Dr. Trout was that of public relations. At the meeting of our Executive Board last June and again yesterday, the central theme of the discussion

was around the problem of developing better public relations — a closer bond, if you please — between this Association, as well as all aspects of dairy science, and the dairy industry generally.

Our great dairy industry in America has developed in a spectacular manner during the past century. Workers in many fields including animal nutrition, animal breeding, dairy processing, chemistry, bacteriology, public health, engineering, and human nutrition have seen their scientific achievements used in this great enterprise. This development was possible only because of the close working relationship between scientists in all these fields, as well as with the dairy industry which was able to put the scientific findings to work. While I realize that the progress during the past century has been little short of miraculous, I firmly believe that workers in the field of dairy science are in position to make a greater contribution to the industry today than ever before. We should be ever mindful of the fact that if our work is to be appraised in terms of monetary value, and many research and educational administrators think that way, it must be put to use by the men in the commercial phases of our dairy industry. Likewise, we must not overlook an opportunity to acquaint those in industry with the value of dairy science and their dependence upon it for future progress.

During the past year I have had an opportunity to visit in several different sections of the United States (but not at the expense of the Association) and to talk with farmers and dairy plant operators. Invariably the conversation finally came around to a discussion of some of the problems of the dairy industry and who is going to solve them. I firmly believe those engaged in the commercial aspects of the dairy industry today are more dependent upon the dairy scientists for immediate assistance in finding the solution to present problems, as well as planning the future pattern of the industry, than was the case fifty or even twenty-five years ago. Many of those with whom I have had an opportunity to talk are in full agreement with this point of view.

I believe the program of this meeting reflects the interest of the American Dairy Science Association in a closer tie-in with industry — or a better public relations program. There are many more papers and symposia included in the program which are of special interest to the less scientifically inclined industry personnel. At the same time, I am sure the scientific level of the program has not been impaired in the least. This is, I hope, only the beginning of an even better and stronger public relations program between dairy science and industry than we have enjoyed in the past.

I have been very much concerned with the matter which we refer to as "problems of the dairy industry." Those of us engaged in academic work no doubt have our individual ideas as to the nature of these problems and those we consider of major importance. I wondered what people engaged in the commercial aspects of the dairy industry considered as major problems of the industry. Consequently, I wrote to a rather long list of people holding positions of leadership in the dairy industry. I asked them to give me the benefit of their thinking as to the problems of that phase of the industry in which they were particularly concerned. I asked them also to indicate the manner in which dairy scientists might be able to assist in the solution of those problems. From many I received replies in which the problems were clearly and concisely stated. Suggestions as to the part dairy scientists might play in their solution also were clearly stated. From others I received replies of the vaguest nature. In fact, the replies of some reminded me of the atheist and the fundamentalist. The atheist says, "There isn't any hell." The fundamentalist says, "The hell there isn't." Some of these could see no major problems nor specific ways in which science could be of service to our industry.

Certainly the problem mentioned most frequently in the replies, and which I feel is of paramount importance, was the need for better trained personnel — on dairy farms, in dairy plants, and in allied industries. It seems that many are interested in this particular item. At least three surveys have been made by different people regarding current interest on the part of college students in the dairy industry as a vocation. Our Committee on Student Affiliate Chapters is also concerned with this matter, and it is their desire to see much more emphasis on this work in the future with the idea of training these young men for positions of leadership as well as to encourage the scientific aspects of their training.

Furthermore, many industry organizations are interested and are doing their bit to encourage young men to choose the dairy industry as their vocation. A few dairy departments, usually through cooperation with their local industry, are publicising the opportunities among the high school seniors of their states. At least one industry organization has

spent a large amount of time and money in developing and distributing a booklet outlining the opportunities for a vocation in the dairy industry. Suffice it to say that the future dairy industry of America will be no stronger than the leaders of tomorrow, who are receiving their training from us today. This is a real challenge to The American Dairy Science Association, and I hope we will accept it.

To discuss each of the many problems would not only be boring to you but would consume far too much time. I am, however, going to read you a partial list of the comments in abbreviated form in order to give you some idea as to how our industry leaders are thinking on the matter of industry problems and how they feel dairy scientists can assist in their solution.

What shall we do about declining markets for certain products — butter and cream in particular?

What shall we do about increased competition from imports of low priced dairy products from abroad?

What shall we do about increased competition from vegetable fats?

We need to educate the public regarding the food value of nonfat milk solids.

We need an inexpensive and accurate test for solids-not-fat in milk.

We need research regarding substances within solids-not-fat as yet undiscovered.

We should breed dairy cattle for higher percentage of solids-not-fat in milk.

More engineering courses are needed in dairy curricula to help meet demands for dairy engineers.

Research is needed on the assimilation of synthetic product fortifiers.

We need a better means of measuring milk in tanks and tank trucks.

Further research is needed into the problem of foam on milk, especially in tank trucks.

Research is needed on more efficient methods of cleaning dairy equipment.

Further study is needed about the causes of heat instability in some milk.

More research is needed in the development of a low fat product to compete with margarine.

We need to develop dairy products with more sales appeal.

Better processing and storage methods are needed.

Dairy scientists should assist in developing a sound pricing system which is not based on butterfat alone.

We must take more active interest in pending legislation on the local, state, and federal levels, assisting in keeping all legislation sound in principle.

We need to continue research in breeding, feeding, and management of dairy herds to make milk production as "profitable" as possible.

We need to eliminate all prejudice from research. "The industry needs to realize that research, to be research, cannot be undertaken to prove anything, but only to determine the facts."

A more understandable interpretation of research findings in the field of dairy science and nutrition with regard to the value of dairy foods is needed by those in industry.

More information is needed on processing products for specific purposes.

Economic studies are needed to show the contribution of dairying to our agricultural and national economy.

A study is needed of breed production testing programs so as to take into account not only butterfat but all the other milk constituents.

Research is needed on quality control of dairy products after purchase by the consumer.

We need to reduce the lag between scientific findings and their practical application in industry.

We need improvement in the technique of getting information to the farmer.

"It has long seemed to me that the dairy industry has gone about as far as it can go in solving its problems until the scientists find out more about milk and 'what makes it tick.' It is indeed a challenge to pure science to discover more about the various constituents of milk and how they act and interact under conditions of concentration, sterilization, drying, freezing, and storage . . . less is known about milk than blood; yet the former has been studied longer and certainly is an easier product with which to work."

I could go on and enumerate other sugges-

tions as to how dairy scientists can assist in the solution of problems having to do with animal disease control and eradication, milk production, feeding, breeding and management of dairy farms, as well as dairy processing plants, quality control, processing, engineering, economics, etc. . . . One final comment I do want to quote, however, because it so well sums up what many of the others were attempting to say. You will detect that the person writing it probably is not a technically trained dairy worker, but he poses some questions which I believe may be of interest to you. ". . . Dairy scientists have contributed greatly to the progress in America through research and education in laboratories, on farms, and in processing plants.

"All this should be continued, but at present it appears that science may well devote itself to the problems posed by the fact that while the dairy industry has a top product, it is falling behind in the competition for markets. Why is this and what can be done about it? Why has there been such an expansion in soft drinks and other beverage sales while there has been only a relatively modest expansion in the sale of milk? If the dairy scientist can contribute to a greater utilization of dairy products at prices that will give the dairy farmer a decent living, he is helping not only to solve dairy problems, but also to improve the nutrition of our people. Why has the consumer failed to appreciate the nutritional merits and economy of dairy products?

"We have talked a great deal about quality. Do we know what quality is and how to attain it? The cheese scientists appreciate the 'tang' of aged cheese, but is this the cheese that gives the most nutrition and pleases most consumers? What kind of butter do consumers really want? Should fluid milk be fortified with nonfat dry milk solids? What about present standards for dairy products? Why are they not more generally used? Are they the standards that if used would give consumers the kind of dairy products they want? Why is so much time and money spent by dairy plants in removing undesirable qualities from milk after it is received rather than spending more time in preventing these undesirable qualities from getting into the milk?"

You will recognize many of the items I have enumerated as being very real problems — problems on which dairy scientists are working and to which they have been, and are gladly, lending every assistance. Others are what might be considered as rehashing ideas of years gone by. Perhaps this is merely an indication that we should place more emphasis on the comment that our scientific findings should be interpreted for the layman in his language in order that the lag between discoveries and developments and their application in industry may be reduced to a minimum.

The type of cooperative effort between science and industry which I believe is very essential may be exemplified by the recently organized Dairy Wide Coordinating Committee on Nutrition Research. Sponsored by the National Dairy Council, fourteen national associations in the dairy industry, including The American Dairy Science Association, accepted an invitation to meet in Chicago on April 24 to discuss the coordination of nutrition research and the dissemination of information to the public. This conference recommended that an effort be made to bring about the purposes expressed in the call of the meeting, and each association was asked to name a representative to become a task force for consideration of specific plans.

That task force met on May 25, and again this Association was represented. At that time the purposes of the project were set forth as follows:

1. To assemble and evaluate from available sources the consumer and professional attitudes toward dairy products as a basis for future nutritional research and promotional programs.

2. To review the existing scientific data in an effort to provide a factual background for public information.

3. To develop suggestions to the dairy industry for additional needed nutrition research to provide facts relative to important areas that have not been covered by research completed or in progress — these to encompass all phases of dairy nutrition.

4. To present to the dairy industry, in nontechnical terms, authentic facts elicited from the research work to be used in public relations and educational work.

I am sure we will wish to commend those undertaking this program and to lend them every assistance possible. It is expected that many of you will be requested to assist in accumulating information and in making suggestions for the most effective procedure.

May I once again state that I believe our dairy industry today is more dependent upon the dairy scientists of America for the solution of their many problems than ever before in its colorful history. Likewise, I believe

dairy scientists must at all times stand ready to assist the industry in the solution of its problems and to provide the springboard for future progress.

I find that what I have been trying to tell you is old stuff, because after I had prepared the statement I have just read, I studied further the record of the meeting of the American Dairy Science Association held here on this campus in 1928. Here is an interesting statement I found in that record: "One of the interesting features of this program was the report of the research committee of the International Association of Ice Cream Manufacturers. . . . This committee would be glad to furnish problems with brief outlines concerning the methods of attack or would be glad to go over existing problems for the purpose of assisting the investigator in arriving at conclusions of value to the industry. . . . Such active cooperation of an industry is especially gratifying to members of the Association and the dairy manufacturers section went on record as approving most heartily this type of cooperation."

Although the exact procedure by which such cooperative effort would function might be somewhat different today, the principle still holds. We must work together — science and industry — if we are to expect the progress of the future to be patterned after that of the past.

Before closing, may I tell one little story? Three farm boys from my good state had never been to New York. They had worked hard during the summer, and before school started in the fall they decided to take a trip to the big city. Arriving in the early afternoon, they checked in at their hotel and were assigned a room on the thirty-sixth floor. After freshening up they went out to see the sights and did not return until the wee small hours of morning. When they walked into the lobby of their hotel they immediately noted that something was amiss. People were bedded down all over the lobby and others were asleep in chairs. Upon inquiring as to the trouble, they were told the elevator operators were out on strike. They were offered mattresses on which they could stretch out for a little rest, but after expressing their appreciation, they refused the offer with the remark, "Oh, that's all right, we're country boys. We are used to lots of exercise. We'll just walk up." Shortly after beginning their ascent, they realized that climbing thirty-six floors was not going to be easy, even for strong legged country boys, so they decided that each one should take a portion of the time to entertain the other two. One boy said he would tell some funny stories during the walk up the first twelve floors, and as a result time passed quite rapidly. Another boy told mystery tales during the next twelve floors, and even they were passed without too much difficulty. But the twenty-fifth floor was passed and they were on their way to the twenty-sixth, and the third boy had not said a word. One of his friends stopping to catch his breath said, "Listen, Bud, you are supposed to be entertaining us during the last twelve flights of steps." The third boy replied, "Well, I am going to tell you sad stories; and I'm going to tell you the saddest story I know for the first one. WE FORGOT THE KEY!"

The key to which I refer in this case is, of course, a close working relationship between the dairy scientists of America and our great dairy industry. It is my opinion that the growth, development, and expansion during the next century can be even more amazing than that of the past 100 years. How successful we are in accomplishing this will depend upon the closeness with which science and industry work. We are on the threshold of a golden era of progress, but let us not forget the key!

* * * *

Chairman Jackson then introduced Dr. W. E. Krauss, Associate Director, Ohio Agricultural Experiment Station, who, as Association representative on the National Research Council, gave an address entitled "Over the Fence."

The opening session adjourned at the conclusion of Dr. Krauss' address.

BUSINESS MEETING
THE AMERICAN DAIRY SCIENCE ASSOCIATION
JUNE 24, 1953

President Henderson called the Business Meeting to order at 9:30 A.M. in Building T-16. There were 300 members present.

REPORT OF THE EXTENSION SECTION

The Extension Section met in Room 206, the Soils Building, University of Wisconsin on Monday, June 22, 1953, and was called to order by Chairman I. E. Parkin at 1:30 P.M. After announcements the following eight papers were presented:

Brucellosis in the United States — C. G. Bradt, Cornell University.

The place of television in the extension program — Floyd J. Arnold, Iowa State College.

Grassland farming — J. M. Fry, Pennsylvania State College.

Pasture management in the rotation plan — Lyman H. Rich, Utah State Agricultural College.

Irrigation, eastern presentation — D. C. Sprague, G. L. F. Farm Products, New York.

Irrigation, western presentation — H. P. Ewalt, Oregon State College.

Evaluating the type and production of offspring resulting from sires used in artificial breeding — Clyde N. Hall, Pennsylvania State College.

Influence of environment and test intervals of estimation of yields of dairy cows — R. E. Erb and A. O. Shaw, State College of Washington.

The register showed 77 present representing 30 states, plus the District of Columbia, Italy, France, and Canada.

The following nominating committee was appointed: Lynn Copeland, Tennessee; Ray Albrectson, New York; G. C. Anderson, Idaho.

The section adjourned to meet Tuesday morning.

The Extension Section met Tuesday, June 23, at 9:00 A.M. in the Soils Building, Stanley N. Gaunt presiding. Two papers were presented:

Demonstration and discussions of a detergent test for butterfat in milk and other dairy products — O. S. Sager, B.D.I., U.S.D.A.

Abnormalities of reproduction — T. Y. Tanabe, Pennsylvania State College. Discussion and slides.

The Section moved to building T 15 where the Teaching Aids Exhibits of the various states were reviewed by Lawrence Johnson, of Michigan State College. Sixteen exhibits by 12 states were in place and discussed briefly. The states having exhibits were: New York, Pennsylvania, Massachusetts, Vermont, North Carolina, Montana, Virginia, California, Utah, Washington, Iowa, and Michigan.

Next, the Section met in business session — Mr. Parkin presiding.

Committee Reports were made by these committees and were adopted:

1. Dairy Records — D. E. Voelker, Iowa
2. Teaching Methods — Lawrence Johnson, Michigan
3. 4-H Club — C. W. Nibler, Nebraska
4. Resolutions — Jerry Heebink, West Virginia
5. Nominations — Lynn Copeland, Tennessee.

J. D. Burke of New York and George Werner of Wisconsin were nominated for Secretary of the Section. George Werner was elected Secretary for the coming year. The incoming Chairman is Stanley Gaunt, Massachusetts; Vice-Chairman, E. T. Itschner, Missouri.

Discussion followed on some of the changes in record forms and procedures proposed by the Records Committee.

Stanley Gaunt, incoming Chairman, announced new committee appointments and led a discussion on program suggestions for next year.

The Extension Section Business Session adjourned at 12:10 P.M.

Registered attendance was 92.

Tuesday P. M., June 23

The Extension Section met jointly with the Production Section at 1:30 P.M. in Agricultural Hall for a symposium on Dairy Cattle Housing, I. E. Parkin presiding. There were 331 present. Papers were presented as follows:

Our dairy cattle housing problems — E. E. Heizer, University of Wisconsin.

Saving money and labor by good barn planning — Stanley Witzel, University of Wisconsin.

Milking equipment for all types of dairying — R. P. Morrissey, International Harvester Company, Chicago, Illinois.

Milk sanitation aspects of dairy cattle housing — H. K. Johnston, Pennsylvania State Department of Health.

In the discussion period which followed, numerous questions on dairy cattle housing were answered by the panel.

The next period was given to Reports of the Joint Committees of the Production and Extension Sections, George Hyatt, Jr., presiding.

J. F. Cavanaugh of Ohio reported for the Pure Bred Dairy Cattle Assoc.

R. E. Erb of Washington reported for the Joint Committee on Breeds Relations. The report was adopted as read.

C. D. McGrew of Ohio reported for the Dairy Cattle Breeding Committee.

The report was adopted with an amendment carrying a recommendation that the Bureau of Dairy Industry reports on records of daughters of sires used in artificial breeding include the state and year in which the records were made.

J. K. Loosli reported for the Dairy Cattle Health Committee. The report was adopted with a minor amendment.

Lynn Copeland reported for the Dairy Cattle Type Committee. The report was adopted as read.

The joint session adjourned at 4:45 P.M.

Wednesday A. M., June 24

Joint Session Extension and Production Sections —

(See Report of Production Section)

Wednesday P. M., June 24

The Extension Section met jointly with the Production Section in Agricultural Hall Auditorium at 8:45 A.M. to hear reports of Subcommittee II of the Curriculum Committee, Dairy Production. George Hyatt Jr. presided.

H. P. Davis and N. N. Allen discussed the dairy production course required and recommended. There was general agreement with the report. It was suggested however, that the proposed curriculum include a statement that candidates be required to show evidence of farm experience. This proposal was accepted by the committee. The amended report of the subcommittee was accepted by motion duly seconded and carried. The joint meeting adjourned for the business meeting of the Association.

On Wednesday afternoon the Extension Section met jointly with the Manufacturing Section in Building T-16 Auditorium for a Symposium on The Bulk Handling of Milk on the Farm and in Transit to the Plant, and on Installation and Maintenance of In-Place Sanitary Pipe-Lines—Farms and Plants.

This symposium took the form of a panel discussion with H. F. Judkins, National Dairy Products Co. Inc., New York as Moderator.

The panel members were:

W. C. Frazier, University of Wisconsin.

Paul Girton, Girton Manufacturing Co., Pennsylvania.

George L. Hopson, DeLaval Company, New York.

Lee H. Minor, Wyandotte Chemical Company, Michigan.

John R. Perry, National Dairy Products Company.

Clarence Weber, New York State Department of Milk Sanitation.

S. A. Witzel, University of Wisconsin.

The discussion was handled by the Moderator presenting questions to various members of the panel who gave their answers. There were also questions from the floor.

All of the discussion was tape recorded and it is understood that mimeographed copies will be distributed to those signing requests.

This, the final session, adjourned at 4:45 P.M.

Respectfully submitted, I. E. Parkin, *Chairman;* S. N. Gaunt, *Vice-Chairman;* E. T. Itschner, *Secretary.*

Upon motion duly seconded, the report was accepted.

REPORT OF THE PRODUCTION SECTION

The Production Section held seven sessions which included Artificial Breeding; Feeding and Techniques; Genetics and Reproduction;

Rumen Physiology and Milk Secretion; Calf Nutrition and Antibiotics; Mastitis, Ketosis, Management and Reproduction; and Calf Nutrition and Silage Preservatives. A total of 109 papers were read as listed in the official program.

The Production Section met for two joint sessions with the Extension Section. During the first session on Tuesday, June 23, a symposium on Dairy Cattle Housing was held with Ivan Parkin serving as chairman during the symposium. George Hyatt, Jr., served as chairman during the reading of joint Extension-Production Section Committee Reports. Details of this portion of the meeting are covered in the report of the Extension Section.

The Joint session reconvened at 8:45 A.M. on June 24, with George Hyatt presiding, to hear the report of Subcommittee II of the Curriculum Committee on Dairy Production Curricula by N. N. Allen, Wisconsin, *Chairman.* Allen moved adoption of the report. The motion was seconded. Following discussion, F. B. Morrison moved that the report be amended to include a statement regarding farm experience — such deficiency to be corrected without credit. Amendment seconded and passed. Motion passed.

The Production Section business meeting was held at 11:00 A.M. Tuesday, June 23, with Chairman Hyatt presiding. The report of the Committee on Antibiotics in Milk was read by W. A. Krienke, *Chairman.* Krienke moved that the report be accepted. Motion seconded and passed. Krienke moved that the Committee be continued and that the production people on the Committee give particular attention to the feeding of milk containing antibiotics. Motion seconded and passed.

A report of the Dairy Cattle Judging Committee was read by Dawdy, who moved its acceptance. Motion seconded and passed.

The report of the resolutions committee was presented by Paul Reeves, *Chairman,* who was assisted by H. O. Henderson and Fordyce Ely. The resolution was as follows:

"Whereas an unusually good program has been planned and arranged for the production section: Therefore, be it resolved that we commend and thank the officers of this section, the program committee and the local committees who have so well planned this series of programs and made arrangements for our needs." Seath moved adoption. Motion seconded and passed.

The Nominating Committee composed of Fordyce Ely, A. O. Shaw, and K. L. Turk, *Chairman,* moved the section elect Phillip L. Kelly, present Vice-Chairman, to serve as Chairman and R. E. Erb, present Secretary, to serve as Vice-Chairman the next year, as has been the previous custom. Turk moved the nominations be closed. Seconded by Loosli. Motion passed.

K. L. Turk further reported that the Nominating Committee recommended the names of R. P. Reece and N. P. Ralston for nomination as Secretary and moved that the nominations be closed. Motion seconded and passed. N. P. Ralston of Michigan was elected Secretary.

The procedure and policy of accepting papers for the section was discussed at some length. Hyatt moved that the call for papers be made in the Journal one month earlier. Motion seconded and passed. Hyatt moved that the deadline for papers be moved from March 15 to March 1 and that the new deadline be rigidly adhered to. Motion seconded and passed. Morrison moved that a committee be appointed to study the whole procedure of paper submission and policy for acceptance of papers for inclusion in the program of the Production Section; the committee to report by December 1, 1953. The new Chairman, P. L. Kelly, is to work with this committee during the coming year. Motion seconded and passed. Norton moved that one night session for presentation of papers for the production section be arranged if the number of papers warrants such a procedure. Motion seconded and defeated.

After remarks of appreciation by George Hyatt, Jr., for the fine cooperation he had received during his term in office the meeting was adjourned.

Respectfully submitted, Geo. Hyatt, Jr., *Chairman;* P. L. Kelly, *Vice-Chairman;* R. E. Erb, *Secretary.*

Upon motion, duly seconded, the report was accepted.

REPORT OF THE MANUFACTURING SECTION MEETING

The Manufacturing Section held two symposia and six sessions, during which contributed papers were presented as listed in the official program of the Association. The first symposium on the subject, Nonfat Milk Solids — Analytical Methods — The Economic Situation, was presided over by Chairman O. F. Garrett. Speakers were by invitation and included R. E. Remaley, American Dry Milk Institute, who introduced the subject and P. D. Watson, U. S. Department of Agriculture; A. G. Leggatt, Ontario Agriculture College;

and H. L. Cook, University of Wisconsin. A paper on this subject by P. F. Sharp was read by A. J. Morris in Dr. Sharp's absence.

The second symposium pertaining to bulk handling of milk and in-place-cleaning of pipe lines was a joint session of Manufacturing and Extension Sections and was organized as a panel discussion. H. F. Judkins, National Dairy Products Company, was the moderator. The panel members were selected by the program committee.

The business meetings were held at 4:00 P.M., June 22 and 11:00 A.M., June 23 with Chairman O. F. Garrett presiding. E. W. Bird, Chairman of the Nominating Committee, presented a slate of candidates from which the following officers were elected for the coming year: W. M. Roberts, Secretary; G. H. Hartman, Vice-Chairman and A. J. Morris, Chairman.

Reports of the following committees were read and accepted as presented and the committees were approved to continue for another year:

1. Joint Committee of the Manufacturing and Production Section on Antibiotics of Milk. W. A. Krienke, Chairman
2. Butter. G. H. Wilster, Chairman
3. Judging Dairy Products. G. M. Trout, Chairman
4. Curd Tension of Milk. H. H. Sommer, Chairman
5. Evaluation of Methods for Determining the Acidity of Cheese Cultures. H. C. Olsen, Chairman
6. Uniform Procedures for Making Acidity Determinations of Fluid Dairy Products. J. G. Leeder, Chairman
7. Nomenclature and Methodology of Milk Proteins. A. M. Swanson, Chairman

The Joint Committee on Antibiotics of Milk was requested to include in their work for this year practical methods of determining antibiotics in milk.

Final reports from committees listed below were presented, accepted and the committees were discharged:

1. Standardizing Methods for Conducting all Phases of the Babcock Test. B. Heinemann, Chairman
2. Standard Plate Count of Milk with Particular Reference to Temperatures of Incubation. M. L. Speck, Chairman
3. Standardization of Alkali Tests and Method of Reporting Results. D. H. Jacobsen, Chairman
4. Standardization of the Babcock Test. E. O. Herreid, Chairman

The Resolution Committee report was presented by Chairman S. T. Coulter and was approved as follows:

1. Whereas there are a number of policies in the operation of the Section which are based on precedent, past practice, and various resolutions that have come before the Section membership and whereas incoming officers may not always be fully cognizant of these policies, be it resolved, therefore, that the membership direct the Section Chairman to appoint a committee whose duty it shall be to assemble these matters of policy into the form of a statement of the policies of the Section and be it further resolved that as new policies are formed, it shall be the duty of the then incumbent Secretary of the Section to incorporate statements thereof in the policy list.

2. Whereas interest has been expressed in a program session dealing with the practical aspects of the operation of the dairy industry as a part of the annual meeting, be it resolved, therefore,
   a. that, additional to the contributed paper sessions and symposia, the 1954 annual program consist of two half-day sessions devoted to diverse subjects of practical interest in the realm of plant operations, engineering, equipment and machinery, buildings, sanitation, new product development, personnel training, quality control, economies, accounting systems, and kindred topics;
   b. that the Section Chairman be empowered to delegate to the Section Vice-Chairman the responsibility of organizing this phase of the program and to appoint two members to serve with the Vice-Chairman.

3. Whereas it is the duty of the Section Chairman to appoint committees as directed by the membership and whereas there have been occasions on which one man simultaneously served as chairman of more than one committee, be it resolved, therefore, that it shall be the policy of the Section that the Chairman of the Section be directed to appoint a member as chairman of not more than one committee.

4. Whereas it has become a matter of policy

to appont a Section Resolutions Committee, be it resolved, therefore, that the section amend its constitution and by-laws by adding the following: The Section Chairman upon taking office shall be required to appoint a Resolutions Committee consisting of three members. The Resolutions Committee shall consider suggestions on matters properly relating to policy and business within the Section and between the Section and other groups, individuals, and other Association Sections, shall formulate these suggestions into resolutions consistent with the needs of the Section and not inconsistent with the Constitution and By-Laws and policies of the Association, and shall present its report to the Section at the time of the first business meeting. The Committee shall exercise its authority to reject suggestions submitted to it for consideration.

The report of the sub-committee number 3 of the Curriculum Committee was given by W. M. Roberts, and was approved as a reference report by the section.

Respectfully submitted, O. F. Garrett, *Chairman;* A. J. Morris, *Vice-Chairman;* G. H. Hartman, *Secretary.*

Upon motion duly seconded, the report was accepted.

REPORT OF THE REPRESENTATIVE OF THE AMERICAN DAIRY SCIENCE ASSOCIATION TO THE NATIONAL RESEARCH COUNCIL, 1952-53

This report is based not only on attendance at the annual meeting of the Division of Biology and Agriculture of the National Research Council, held April 24, 1953, at the National Academy of Science, but on participation in two meetings of the Agricultural Board, one meeting of the Committee on Animal Nutrition, one meeting of the Committee on Milk Production, Distribution and Quality, and one meeting of the Executive Committee of the Division of Biology and Agriculture. The report will be concerned with items of special interest to the American Dairy Science Association.

Agricultural Board

During the year the *Committee on Milk Production, Distribution and Quality* of the Agricultural Board published a final report (Publication No. 250 of the National Academy of Sciences, National Research Council) entitled, "Sanitary Milk Control and Its Relation to the Sanitary, Nutritive and Other Qualities of Milk." This document should be a classic in its field and is of interest to every member of the Association, as well as to Boards of Health, public health officials, milk producers and distributors, and the general public. It may be of more than passing significance that the project director and several members of the Committee are active members of the American Dairy Science Association.

The *Committee on Animal Health* of the Agricultural Board is preparing reports on the extent and causes of losses in young pigs and calves. After reorganization this committee will concern itself with the use of antibiotics, infertility in dairy cattle, and rumen physiology as related to bloat.

The *Committee on Animal Nutrition* has a sub-committee on dairy cattle which is constantly accumulating data for subsequent revision of the bulletin on nutrient allowances for dairy cattle. Two other sub-committees are preparing reports on hormonal applications and on the role of fluorides in animal feeding.

The *Committee on Public Health Aspects of Brucellosis* is preparing a report on the epidemiology of brucellosis as a sequel to its two previous reports, "The Control of Brucellosis in Animals" and "Diagnostic Criteria for Human Brucellosis," both published in the Journal of the American Medical Association.

The *Committee on Laws, Rules, and Regulations Governing Animal Health* prepared a voluminous report covering available information in this field through 1946. A condensed mimeographed version of this report has been prepared for limited distribution in order to determine the need for bringing the information up to date.

The *Committee on Feed Composition* is collecting data on the nutrient content of by-product feedstuffs. The work of this committee has been accelerated through employment of a technical secretary who is now enlisting the cooperation of industrial, government, and academic laboratories in providing nutrient analyses. It is urged that all members of the American Dairy Science Association having applicable data respond to a request for feed composition data that may come from this committee.

During the year two previously existing committees of the National Research Council were affiliated with the Agricultural Board in order to broaden the Board's scope of activities to include the plant sciences and other fields basic to agricultural production: Com-

mittee on Preservation of Indigenous Strains of Maize and Committee on Plant and Crop Ecology. With these additions, work potentials are included in the fields of aerobiology, agroclimatology, conservation, crop geography and vegetation analysis, plant crop yields, and plant diseases and pests.

A *Committee on Range and Pasture Management* is now being organized and will become functional as soon as preliminary studies on the problems involved in this area make possible a clear definition of the activity needs of such a committee.

Membership on the Board has been extended to include the chairman of these two committees, as well as an agricultural economist and an agricultural engineer.

At the last annual meeting of this Association, a request was made that the Agricultural Board give consideration to appointment of a Committee on Animal Breeding. At the present time, organization and personnel of such a committee and a listing of problems with which it might be concerned are being given careful consideration.

Agricultural Research Institute

Organization of the Agricultural Research Institute has continued. The Proposed By-Laws were modified, adopted and reprinted. A Governing Board and officers were elected according to the By-Laws. Dr. R. C. Newton, Vice-President of Swift & Company, is Chairman of the Agricultural Research Institute. The Agricultural Research Institute now has 37 class A (paying) members representing the major agricultural industries of the country, and 69 class B (non-paying) members. Of these latter, 17 are federal agencies, 33 are experiment stations, and 19 are scientific societies, of which the American Dairy Science Association is one.

At the present time the Projects and Proposals Committee of the Agricultural Research Institute, made up of five representatives of industry, two of experiment stations, and one of a federal agency, is soliciting and considering proposals for fields of activity in which committees of the Agricultural Board might engage. Dr. R. M. Bethke, Vice-President of the Ralston Purina Company, St. Louis, Missouri, is Chairman of the Projects and Proposals Committee and would welcome suggestions for consideration by his committee.

Food and Nutrition Board

The *Committee on Milk* entered testimony in the Ice Cream Standard hearings, endorsing standards for ice cream and low-fat frozen products which would encourage maximum utilization of nonfat milk solids for human consumption. The Committee has favored fortification of skimmilk for home consumption with vitamin D and possibly vitamin A, but further progress in this respect is dependent on finding out how to stabilize these vitamins in the dry product.

Other committees of the Food and Nutrition Board have continued their activities in the areas of food protection, food fortification policy, definitions and standards of identity, institutional feeding, dietary allowances, nutritional anthropometry, and therapeutic nutrition.

Dr. L. A. Maynard is now Chairman of the Food and Nutrition Board and is also a member of the Executive Committee of the Agricultural Board. This liaison between the two boards is most desirable, as some of the problems considered by each supplement each other and at times require joint consideration.

American Institute of Biological Sciences

The American Institute of Biological Sciences, organized in 1948 under the sponsorship of the National Research Council, now has 17 member societies, 10 affiliate societies, and 18 associates. The total membership of the 27 societies represented exceeds 30,000.

The specific aims of the American Institute of Biological Sciences include (1) assistance to biological societies and similar organizations in matters of common concern which can be dealt with most effectively by united action; (2) promotion of unity and effectiveness of effort among all who are devoting themselves to the biological sciences by research, by teaching, or by application of biological data; (3) furthering the relationships of the biological sciences to other sciences and to the arts and industries; and (4) cooperation with local, national, and international biological organizations.

The American Institute of Biological Sciences publishes the AIBS Bulletin and the Bio-Sciences Newsletter and is in the process of publishing a Handbook of Biological Data, the first fascicle of which, "Standard Values in Blood," is now in book form (W. B. Saunders Company).

The American Institute of Biological Sciences undertakes arrangements for an annual meeting of member and affiliated societies, conducts a placement service, serves as the operating agency for the newly created Institute of Animal Resources (laboratory ani-

mals) and assists in carrying out programs that individual societies may not alone be able to manipulate. It is studying problems involved in the publication of scientific journals. Opportunities for biologists in commercial and industrial enterprises are being investigated. The American Institute of Biological Sciences is in a position to work with the Office of Scientific Personnel, the National Science Foundation, Selective Service, and military agencies on matters pertaining to biologists. In spite of all these activities the AIBS does not duplicate or overlap functions of the National Research Council. Operational functions are not a major part of National Research Council activities. The AIBS performs these functions. Representation of societies to the National Research Council is a voluntary enterprise; in the American Institute of Biological Sciences member and affiliated societies have a vested interest.

The American Dairy Science Association has been considering the matter of membership in the American Institute of Biological Sciences. It is the opinion of your representative that the AIBS warrants support of the American Dairy Science Association and that affiliate membership (costing probably $100) be requested at this time. This recommendation is made rather than that of full membership because: (1) the American Dairy Science Association has a mixed membership including many who are not engaged in scientific work; (2) the annual assessment would be $1,000 which means that annual dues of members of the American Dairy Science Association probably would need to be increased accordingly.

Each year the progress of the American Institute of Biological Sciences should be reviewed and consideration be given to the possibility and advantages of full rather than affiliate membership.

Fellowships

1953-54

National Research Council postdoctoral fellowships, carrying a stipend of $3,400, were awarded to 4 out of 77 applicants in the general field of biology. Four Lilly Fellowships and 5 Merck Fellowships carrying stipends of $3,400 and $6,000, respectively, also were granted.

The *National Science Foundation* awarded 42 postdoctoral fellowships (stipend $3,400) but only 24 were accepted. Since the National Science Foundation has no mechanism whereby alternates can be appointed, 18 fellowships were lost. It would be entirely proper for the American Dairy Science Association to request the National Science Foundation so to amend its rules and regulations regarding the selection of applicants to provide for alternates.

The National Science Foundation received 2,936 applications for predoctoral fellowships (stipend $1,400 first year; $1,600 second year; $1,800 third year). Of these, 1,385 were recommended by a screening committee and 515 awards were made, of which 142 were in the field of biology.

Under the Fulbright program for lecturing and research abroad, 1,850 applications were received, of which 170 were in biology and agriculture. A total of 304 awards were made, of which 31 were in biology and agriculture.

It was reported that Finland, Sweden, Germany, and Ceylon have been added to the Fulbright program.

General

The Division of Biology and Agriculture of the National Research Council has increased the tempo of its activities under the dynamic leadership of its chairman, Dr. Paul Weiss of the University of Chicago. In his opinion chemistry and physics have been in the limelight but now this is the century of biology. The prestige of the National Research Council continues to grow and its advice is being sought more frequently in high places. The State Department recently gave the National Research Council power to recommend delegates to international congresses. In order to familiarize the scientists and laymen of the country with the National Research Council and the general role of the scientist in our total economy, a popularly written brochure is being prepared for widespread distribution. All indications point to the need for individual scientific societies continuing and strengthening their relationships with the National Research Council.

Respectfully submitted, W. E. Krauss.

Upon motion duly seconded, the report was accepted.

EDITOR'S REPORT FOR THE YEAR 1952

Volume XXXV of the *Journal of Dairy Science* was published during 1952. This volume contained 1,280 pages, of which 1,064 were devoted to original articles and a review, 98 to abstracts, and 118 to miscellaneous items including Association announcements, program abstracts and proceedings of the Annual Meeting, table of contents, and indices for both orig-

inal articles and abstracts. The original articles included 55 in manufacturing, one review on a manufacturing subject, and 81 in production, for a total of 137. The number of abstracts in the Abstracts of Literature section was 651, a slight decrease from 1951. In addition to appearing in the May and June issues, the program and abstracts of papers for the Annual Meeting were printed as a separate for distribution at the Annual Meeting; type set for the *Journal* was used, so the cost of the separate was minimized.

Up to October 15, 1952, when the manuscripts on hand were turned over to the editor-elect for processing, 23 manuscripts were rejected or withdrawn during 1952. This represents a slight increase over previous years.

Although the Executive Board voted in June to continue publication of the Abstract Section as an Association project, reorganization and expansion of this section was not attempted by the outgoing editor. I felt that the incoming editor should be saddled by a minimum number of decisions reached by his predecessor.

The checking of galley and page proof for the decennial index for volumes XXI to XXX was completed under the old editorship. Decisions relative to number of copies to be printed and procedures for making the index available to members and subscribers were left in the hands of the Secretary.

The indices for volume XXXV were prepared by D. D. Deane. His work on this project was appreciated very much. The fine assistance of Margaret Lange and Carolyn Nelson in handling many of the functions of the editorial office has been extremely helpful. The splendid cooperation of many members of the Association in the publishing of the *Journal* is acknowledged with great gratitude; the publication is truly a cooperative project.

Respectfully submitted, F. E. Nelson.

Upon motion duly seconded, the report was accepted.

EDITOR'S REPORT

Volume 36, Nos. 1-6, January-June 1953

An attempt has been made by the new editor to maintain the high standards previously set for the *Journal*. In the first six issues of volume 36 there have appeared 75 manuscripts of original research and one review article. Fifteen articles have been rejected on the recommendation of the reviewers. On a subject matter basis, these published articles can be classified as follows:

	No.	*Per cent*
Nutrition	18	23.7
Chemistry	13	17.1
Bacteriology	12	15.8
Artificial insemination	9	11.9
Physiology	9	11.9
Genetics	6	7.9
Animal diseases	2	2.6
Nutrition (human)	2	2.6
Sanitation	2	2.6
Engineering	1	1.3
Herd management	1	1.3
Plant operation	1	1.3
Total	76	

Classifying these manuscripts on the basis of those that might be considered of primary interest to workers in the field of dairy manufactures and those that might be considered of primary interest in the field of dairy production, it is found that 50 (65.8%) belong in the production category and 26 (34.2%) in the manufacturing.

An attempt has been made to streamline the abstract system of the Journal. Details of a new plan under consideration will be explained to the membership when the arrangements have been completed.

A new section has been added, called "People and Events," which has as its purpose the dissemination of news about people and developments in the industry and the Association. A feature of the column is a guest editorial written by invitation from the editor. It is hoped that this column can be expanded in its scope, which will be possible with the proper cooperation of the members. Official news gatherers have been appointed at each college of agriculture and in the U. S. Department of Agriculture.

Beginning with the January, 1953, issue the Journal has been published by the Garrard Press, Champaign, Illinois. This change has made possible certain economies and innumerable conveniences for the editor.

At the suggestion of the President, studies were made of the possibilities of a second journal. A prospectus prepared by the Garrard Press was sent to the officers and members of the Journal Management Committee. A trip was made by the editor to Madison, Wisconsin, to study the methods employed by the American Society of Agronomy in the publication of its three journals. As a result of this study a brochure and questionnaire on the proposed new journal were prepared and mailed to the membership.

An article is being prepared for publication in an early issue of the Journal which will deal with suggestions for authors. These suggestions, giving abbreviations and style used in the Journal, should simplify the problem of manuscript preparation for authors and reduce the cost to the Association of the extensive editing presently needed on many manuscripts.

The editor wishes to acknowledge the helpful suggestions of the retiring editor, F. E. Nelson, the cooperation of the associate editors and the Journal Management Committee; and the able assistance of Rosamond Tracy, E. E. Ormiston, the assistant editor, and James Hill of the Garrard Press in the performance of the many routine duties connected with the editing and publishing of a scientific journal.

Special recognition is given also to the many reviewers of manuscripts whose critical comments make possible the maintenance of a high editorial standard in the various specialized fields covered by the *Journal*. Finally, the editor wishes to express his appreciation to the associate editors, and to the abstractors and section editors who have faithfully contributed to the abstract section of the *Journal*.

Respectfully submitted, P. H. Tracy, *Editor*.

Upon motion duly seconded, the report was accepted.

SECRETARY-TREASURER'S REPORT

Once again it is possible to report that the calendar year of 1952 was a successful one both financially and operationally. The future looks very favorable, but there are some real problems to be considered and solved during the next administration.

The bulk of this report of necessity deals with the calendar- and fiscal-year of 1952. Facts, figures and reports for the five months of 1953 will be included as addenda to this report but it must be borne in mind that this is essentially a 1952 report.

Membership

The following is a summary of our gains and losses for 1952:

Membership, December 31, 1951		1,598
Gains:		
New Members	52	
Former Student Affiliates	40	
Total Gain	92	
Losses:		
Resigned	12	
Delinquent	120	
Deceased	4	
Total Loss	136	
Net Membership Loss		44
Membership, December 31, 1952		1,554

While we did lose a number of members in 1952, our loss was 93 less than for 1951, which seems to indicate a turn from the steadily increasing losses experienced over the past several years, to an increase in membership in the not too far distant future. In fact, as of June 1, 1953 our membership stood at 1,643 which is already an increase of 89 persons for 1953 over the total for 1952.

Former student affiliates who assumed full membership upon graduation, showed an increase of 13 over the number that joined in 1951. There are two factors that contribute to this, each one nowhere near its peak of potential. As dairy departments send in the names of those student affiliates who have graduated, the Secretary sends a personal membership invitation to each one. This plan has been in operation for two years and is apparently due to play an increasingly important role as more departments cooperate. The second factor is the increasingly active role of the Student Affiliate Committee which is building increased interest in the Association. This interest tends to carry over after school days are at an end.

Much credit must be given the Membership Committee of the Association for the fine job it has done in arousing interest in getting new members. Certainly, through the new brochures, which have been prepared, we are moving forward. It is to be hoped that this particular committee will be continued as an integral and highly functional permanent committee of the Association.

The big four in Association membership for 1952 were New York, Illinois, Wisconsin, and Ohio.

Student Affiliates

Student affiliate membership stood at 264 at the close of 1952. As of June 1, 1953 the number stands at 270. Not a big increase, but an indication. With steadily declining numbers of dairy majors, the job of building our membership in this department becomes an ever more important one.

On December 31, 1952 there were 23 Student Affiliate Branches. As of June 1, two

additional clubs requested certificates. This brings the total to 25 — leaving 23 states without affiliation.

The Student Affiliate Committee has a real challenge and needs the help of all to see this program through.

One program carried out in 1952-53 was to offer the 1953 *Journal* plus the October, November, and December 1952 issues to all *new* student affiliates who paid their 1953 dues prior to November 1, 1952. There were 117 new student affiliates who paid their dues under this plan.

Circulation

The *Journal of Dairy Science* reached a circulation of 3,357 for 1952. This includes the United States, its territories, and 45 foreign countries. Circulation fell off by 322 copies in 1952 as compared with 1951, but as of June 1, 1953, the *Journal* is going to 206 more persons than it did on June 1, 1952.

Finances

While the Association realized an operating profit of $1,535.31 for 1952, the costs of nearly all phases of the operation of the organization have also increased. Whether a like operating profit can be shown in 1953 remains to be seen.

The *Journal* carried a total of 102.75 pages of advertising during 1952. For the first six months of 1953, the pages carried total the same as for 1952. Your Association grossed $7,636.11 from 1952 advertising. This was $432.06 more than for the previous year.

Treasury Bonds amounting to $7,000.00 matured during the year and were re-invested in Series F bonds.

A detailed audit of the Association's financial status was sent to all members of the Executive Board.

Decennial Index

The Decennial Index, covering volumes XXI-XXX was received from the printers and placed on sale to members on May 1, 1953. Sales are moving fairly steadily.

The Secretary-Treasurer wishes to take this opportunity to express his sincere appreciation to all officers, Board members, and members who have aided materially in making 1952 another successful year in Association history.

Respectfully submitted, P. R. Ellsworth, *Secretary-Treasurer.*

Upon motion duly seconded, the report was accepted.

AUDITING COMMITTEE REPORT

To the Executive Board and Members of The American Dairy Science Association
Gentlemen:

On May 29, 1953, Mr. Walter C. Burnham, a Certified Public Accountant, met with the Auditing Committee of The American Dairy Science Association. At that time Mr. Burnham's report of his audit of the Association's business for 1952 was considered.

Mr. Burnham has made a thorough examination of the records. He has checked the bank statements and examined all the U. S. Government Bonds. Mr. Burnham has check-tested the inventory of Journals and Twenty-Year Indexes to assure accuracy of the physical inventory.

The Auditing Committee is satisfied that the financial statement for the year 1952 is correct. The committee wishes to commend Mr. Burnham, the auditor, for his fine work and excellent report. We recommend that the financial statement be accepted by The Executive Board and the members of The American Dairy Science Association.

Respectfully submitted, C. D. McGrew, *Chairman;* H. H. Weiser; T. D. Harman.

Upon motion duly seconded, the report was accepted.

REPORT OF THE JOURNAL MANAGEMENT COMMITTEE

The work of the committee during the past year has included some unusual problems of interest to the members of the Association.

1. Dr. Paul H. Tracy has succeeded Dr. F. E. Nelson as editor of the *Journal of Dairy Science.*
2. A new section in the *Journal* called PEOPLE AND EVENTS has been started and seems to have met with general approval.
3. Garrard Press, Champaign, Illinois, succeeded Science Press Printing Company, Lancaster, Pennsylvania, as publisher of the *Journal.*
4. The Ten-Year Index of volumes 21-30 has been published, thanks to Dr. Harold Macy, University of Minnesota, the compiler, and Dr. F. E. Nelson, supervising editor.
5. The Committee recommended that a competent, experienced representative be carefully selected to develop the advertising section of the *Journal of Dairy Science* to increase this source of revenue.
6. A survey of subscribers to the *Journal* has been made to determine reaction to the publication of a second journal of more popular nature by the Association.
7. The Editor has requested the appointment of an editorial board to review and edit papers submitted for publication. Mem-

bers of this editorial board will be approximately ten in number and will be selected to represent the broad interests and phases of the research papers now published in the *Journal*. This request for the editorial board has been recommended by the Journal Management Committee to replace the present board of Associate Editors.

8. Much of the work of the assistant editor will be assumed by the editorial board. E. E. Ormiston, who has given the Editor invaluable editorial assistance in the past few months, has resigned from his position as assistant editor.
9. The Committee has recommended, at the request of Dr. Tracy, that editors of the various sections of the Abstracting Service be eliminated and that a new editor of abstracts be appointed to assume the responsibilities of editing, organization, and development of the Journal Abstracts.
10. Dr. K. L. Turk, Cornell University, has been recommended as the new member of this committee to replace the retiring chairman, W. V. Price. The chairman of this committee for the coming year will be Dr. Ralph E. Hodgson, United States Department of Agriculture.

Respectfully submitted, J. Hoffman Erb; Ralph E. Hodgson; Walter V. Price, *Chairman*.

Upon motion duly seconded, the report was accepted.

REPORT OF THE COMMITTEE ON STUDENT AFFILIATE CHAPTERS

Your Committee on Student Affiliate Chapters has been charged with the task of studying the student affiliate program with the primary objective of bringing about a stronger tie between dairy students and the American Dairy Science Association.

During the Association year 1952-53, there were 23 active Student Affiliate Chapters of the American Dairy Science Association located at the following institutions:

Alabama Polytechnic Institute
University of Florida
University of Georgia
University of Kentucky
University of Massachusetts
Michigan State College
University of Minnesota
University of Missouri
Montana State College
University of Nebraska
Oklahoma A & M College
Pennsylvania State College
Clemson College
University of Tennessee
Texas Technological College
Virginia Polytechnic Institute
State College of Washington
West Virginia University
Ohio State University
University of Idaho
Rutgers University
Cornell University
Texas A & M College

In addition, applications for Student Affiliate Chapters have recently been received from the University of Maryland and Mississippi State College.

As of June 1, 1953, there were 270 student affiliate members of the Association. The record of affiliate memberships for the past 5 years is as follows: 1949 — 859; 1950 — 750; 1951 — 340; 1952 — 264; 1953 — 270.

As a result of the activities of the Committee during the past three years, two major plans for strengthening the student affiliate program have emerged. One plan involves the formation of a national organization of dairy students, so organized that it would have national student officers and an annual meeting of delegates from the various clubs. The other plan involves the publishing of a student newsletter, possibly at quarterly intervals during the school year. It is obvious that in order to assure the success of either of these projects, the wholehearted cooperation of the majority of dairy clubs must be forthcoming.

During the past year a questionnaire was prepared and mailed to all dairy departments. The questionnaire was primarily designed to secure student reaction to the aforementioned plans, as well as other information needed for the purpose of evaluating the present status of the student affiliate program. At the writing of this report, 28 replies had been returned out of 51 questionnaires mailed out. Dairy clubs were either non-existent or inactive at 8 of the institutions replying. An analysis of the replies revealed the following facts and opinions:

1. Nine of the 20 active clubs replying were not student affiliate chapters of A.D.S.A. Principal reasons given were: lack of benefits of affiliation; students not interested — already over-organized; composition of club — not strictly a dairy club; and lack of information regarding affiliation.
2. The leading reasons given for the marked decline in student memberships during the past five years were the decrease in

enrollments and the increase in membership dues. Other pertinent reasons given were: Journal is too technical for student use; copies of Journal available in libraries; and affiliate program not fully explained to students.

3. Student opinion regarding the formation of a national organization of dairy students was about equally divided. This is in accordance with opinions expressed by faculty members replying to an earlier questionnaire mailed out by the Committee in 1951.
4. Eighteen of the 20 clubs replying expressed definite interest in a student newsletter. In practically every case, the faculty advisor to the club agreed to assume the responsibility of supervising the sending of news items to the editor of the letter. Suggestions for types of news items to be included in such a letter included: outstanding activities of dairy clubs; announcements of scholarships available for graduate study; employment opportunities available; guest editorials; and new developments in the dairy field of interest to the dairy student.

A luncheon meeting of advisors to dairy clubs was held during the A.D.S.A. meeting in June 1952. Although time did not permit an extensive discussion of the student affiliate program, the work of the Committee and its objectives were outlined to the group present. In view of the highly favorable reaction to a meeting of this nature, the Committee scheduled a breakfast meeting to be held in conjunction with the 1953 annual meeting of the A.D.S.A. An invitation was extended to include student affiliate members and all others interested in the welfare of the dairy student.

In consideration of the facts and opinions reviewed by the Committee during the past year, the following courses of action aimed at strengthening the student affiliate program are recommended.

1) That the suggestions listed in the Student Affiliate Committee Report of 1951 be given further consideration and that those which have not been activated be put into effect as soon as possible.
2) That provisions be made for the preparation of a dairy student newsletter for initial publication during the coming school year. That the letter be published either quarterly or even at less frequent intervals if this is deemed more feasible. The possibility of soliciting advertisements from commercial concerns as a means of helping finance such a publication has been suggested. It is further recommended that, initially at least, the letter be distributed to all dairy students whether affiliate members or not. Items to be published in such a letter may include Association announcements of concern to dairy students; news of outstanding club activities; opportunities available for graduate study; job opportunities in the field; editorials of an appropriate nature; and other items concerned with the welfare of the dairy student. It is believed that no difficulty should be encountered in obtaining editorial assistance from among interested members of The American Dairy Science Association who would assume the responsibility for getting the newsletter ready for printing or mimeographing. It is the belief of the Committee that such a newsletter can serve to keep the dairy student better informed about activities in the field directly concerned with his welfare. This it is believed should result in stimulating the interest of the student towards more active participation in a student affiliate program aimed at strengthening not only the local clubs but ultimately the national Association as well.
3) That further steps be taken to stimulate interest in a national student organization. In furthering this objective, it is suggested that greater efforts be made to encourage students to attend regional and national meetings of The American Dairy Science Association. Furthermore, it is recommended that formal provisions be made at such meetings for student gatherings and for recognition of those attending.

The Committee wishes to express its sincere appreciation to those who have assisted with its work during the past year.

Respectfully submitted, M. L. Dawdy; I. I. Peters; A. C. Ragsdale; F. B. Wolberg; E. L. Thomas, *Chairman*.

On motion duly seconded, the report was accepted.

CURRICULUM COMMITTEE REPORT

H. P. Davis, Chairman of the Curriculum Committee, called on the Chairmen of the Curriculum Sub-Committees to present brief reports. The reports were accepted. Professor

Davis then moved that the entire Committee Report be accepted, reproduced and published. Motion carried.

REPORT OF THE REPRESENTATIVE ON THE RALSTON-PURINA FELLOWSHIP AWARDS COMMITTEE

It has been my pleasure to represent the American Dairy Science Association on the Ralston-Purina Fellowship Awards Committee during the past five years. After assisting in the development of the program, I served a two-year term and then was reappointed for a three-year term which has now been completed.

In 1949 the Ralston-Purina Company announced their interest in sponsoring a Fellowship program to help train leaders who are needed in the scientific fields of livestock and poultry production. This program was developed by a committee of five — one member each from the Poultry Science Association, American Veterinary Medical Association, American Dairy Science Association, American Society of Animal Production and the Association of Land Grant Colleges. This committee established the rules for the Awards program which involves the awarding of seven graduate fellowships with stipends of $1,560 on an annual basis in the fields of (1) nutrition and physiology research as applied to dairy, poultry and animal husbandry; and (2) research in transmissable diseases of livestock and poultry.

Approximately 40 to 50 applications have been received each year and the awards have been given to outstanding graduate students based entirely on the selections of the Awards Committee. Many of the recipients have now assumed positions of leadership in the research field and are making real contributions to a more important livestock industry in this country.

I wish to compliment the Ralston-Purina Company on their splendid support and cooperation in the training of leaders for service in the research fields of livestock production. This is a fine program, handled in an excellent manner by Mr. J. D. Sykes, Vice-President, giving full charge and responsibility for the selection of the recipients of the fellowships by the members of the Awards Committee.

I have appreciated the opportunity of representing the American Dairy Science Association on the Ralston-Purina Awards Committee.

Respectfully submitted, K. L. Turk.

Upon motion duly seconded, the report was accepted. The President was instructed to write a letter of appreciation to the Ralston-Purina Company to accompany a copy of the above report.

DAIRY SCIENCE TEACHING AWARD COMMITTEE REPORT

S. M. Salisbury gave a progress report for the Dairy Science Teaching Award Study Committee. Upon motion duly seconded, the report was accepted.

RESOLUTIONS COMMITTEE REPORT

WHEREAS: The 48th Annual Meeting of the American Dairy Science Association has been held on the beautiful campus of the University of Wisconsin at Madison, and

WHEREAS: The host institution undertook the task and responsibility of arranging the details necessary for the successful conduct of the annual meeting, and

WHEREAS: The arrangements that have been made by the local institution have been more than adequate in every detail, thus permitting this Association to hold one of its most pleasant and successful meetings enjoyed by men, women and children alike,

Therefore be it RESOLVED: That the American Dairy Science Association extend its sincere appreciation for the courtesies extended and the services provided for by the University of Wisconsin, to Dr. Edwin B. Fred, President, University of Wisconsin, to Dean Rudolph K. Froker, Dean of the College of Agriculture, and especially to Dr. H. C. Jackson, Dr. E. E. Heizer and their associates who contributed so much toward making possible this successful meeting.

WHEREAS: Many commercial organizations have contributed greatly to the success and enjoyment of the 48th Annual Meeting,

Therefore, be it RESOLVED: That the American Dairy Science Association express to those organizations its sincere appreciation.

WHEREAS: The Borden Company Foundation has for the seventeenth year made available for presentation by the American Dairy Science Association the Borden Awards for outstanding research in dairy production and dairy manufacturing,

Therefore, be it RESOLVED: That the American Dairy Science Association express its appreciation to the Borden Company Foundation for these Borden Awards by which the American Dairy Science Association may recognize achievement in the fields of dairy production and dairy manufacturing research.

WHEREAS: The American Feed Manufacturers Association has made available to The

American Dairy Science Association the 6th American Feed Manufacturers Award for outstanding research in dairy cattle nutrition, and has pledged an additional 3 year series of such awards.

Therefore, be it RESOLVED: That the American Dairy Science Association express its appreciation to the American Feed Manufacturers Association for this award by which recognition is given to outstanding research in dairy cattle nutrition.

WHEREAS: The DeLaval Separator Company has again made available an award for outstanding achievement in the field of dairy extension,

Therefore, be it RESOLVED: That The American Dairy Science Association express its sincere appreciation to the DeLaval Separator Company for the award by which outstanding work in the field of dairy extension may be recognized.

WHEREAS: The American Dairy Association and the National Dairy Council are effectively promoting the sale and use of milk and other dairy products,

Therefore, be it RESOLVED: That The American Dairy Science Association go on record as commending the efforts of these organizations and other groups or agencies who seek to promote the wider use of milk and its products.

Upon motion duly seconded, the report was accepted.

REGISTRATION COMMITTEE REPORT

Registration for the 48th Annual Meeting totaled 1,632 for an all-time high. Registrants came from 46 states, Cuba, Puerto Rico, Canada, and 10 foreign countries. A detailed breakdown follows:

State	*Members*	*Non-Members*	*Women*	*Children*	*Guest*	*Student Affiliates*	*Totals*
Alabama	5		3	1		1	10
Alaska	1						1
Arizona	5		2				7
Arkansas	2		2	2			6
California	7	2	1	3			13
Colorado	1						1
Connecticut	8		1	2		3	14
Delaware	3		3	3			9
Florida	6		1	1			8
Georgia	5		2	1			8
Idaho	1						1
Illinois	110	45	40	22	9	6	232
Indiana	15	8	4	1	1	7	36
Iowa	24	15	15	9		7	70
Kansas	16	1	3	6		1	27
Kentucky	12	1	4			12	32
Louisiana	4		2	3			9
Maine	2		1				3
Maryland	20	12	7	2		2	43
Massachusetts	7		3				10
Michigan	26	2	10	6		3	47
Minnesota	42	15	23	15		15	110
Mississippi	7		1				8
Missouri	16	7	6	3		3	35
Montana	3		2	2		2	9
Nebraska	13	1	8	10			32
Nevada							0
New Hampshire	3	1	1				5
New Jersey	11	1	6	7			25
New Mexico							0
New York	56	5	31	16	2	8	118
North Carolina	17	1	2			2	22

State	*Members*	*Non-Members*	*Women*	*Children*	*Guest*	*Student Affiliates*	*Totals*
North Dakota	6			2			8
Ohio	44	6	22	20		4	96
Oklahoma	8	1	5	6		2	22
Oregon	5		2	2			9
Pennsylvania	27	9	11	14		1	62
Rhode Island	1		1	2			4
South Carolina	3		1	1			5
South Dakota	6		2				8
Tennessee	10	1	4	3			18
Texas	6	1	4				11
Utah	4	1	4	2			11
Vermont	4			1			5
Virginia	11	2	8	1	1	3	26
Washington	10	2	3			3	18
Washington, D.C.	6	5	2		3		16
West Virginia	6						6
Wisconsin	76	20	38	47	84	41	306
Wyoming	1						1
Cuba	1						1
Canada	12	8	4				24
Puerto Rico	1						1
Italy		5					5
France		6					6
Equador		1					1
Austria		1					1
Norway		2					2
Yugoslavia		3					3
Brazil		1	1				2
Sweden		1					1
England	1						1
India		1					1
	697	194	296	219	100	126	1632

Respectfully submitted, V. R. Smith, *Chairman.*
Upon motion duly seconded, the report was accepted.

EXECUTIVE BOARD MEETING

The Executive Board transacted the following business:

Approved the minutes of the 1952 annual meeting.

Approved the Editors' Reports.

Approved the Secretary-Treasurer's Report.

Accepted the Auditing Committee Report.

Accepted the Historian's Report, and, based upon the Historian's recommendations, instructed the President to appoint a committee to investigate the cost and worthwhileness of a pamphlet, brochure, or other device publicizing the 50th Annual Meeting of the Association, which will be held at Michigan State College in 1955.

Approved the selection of H. P. Davis as Honorary Member for 1953.

Accepted the report of the Student Affiliate Committee.

Accepted the report of the Association Programming and Management Committee. The Board approved the recommendation of this committee that the annual meeting programs and copies of abstracts be prepared for future meetings in the same manner as they are now being distributed.

The Association approved the points as outlined in the report of the Programming and Management Committee covering time of the annual business meeting, the establishment of new sections, number of symposia, reports of other organizations, annual meeting abstracts,

procedure for conducting section business, annual meeting publicity, annual meeting costs, student affiliates, and recipients of the Association awards. The Executive Board further approved the following recommendations pertaining to over-all management:

1. That one office should be responsible for the business aspects of the Association in handling all financial matters.
2. That the handling of subscriptions and memberships shall be continued on the same basis as in the past.
3. For the present, the warehousing of extra copies of the *Journal* will be handled as follows:
   (a) All back numbers of the *Journal* now being stored under the jurisdiction of the Secretary-Treasurer at the Ohio State University will continue to be stored in this location unless the Secretary-Treasurer is changed;
   (b) Extra copies of recent issues of the *Journal* will be stored with the publisher.
4. No additional duties will be assigned the publisher at this time other than those indicated in the recommendations above and those which have already been assigned to him in accordance with the routine practices already in effect.

The Board further approved the recommendations of the Programming Committee outlining the duties of the Secretary-Treasurer as follows:

1. Responsible for all financial matters.
2. Responsible for all billing, receipts, and records relative to members and subscribers.
3. Responsible for all matters pertaining to promotional activities of the Association.
4. Responsible for coordinating all activities of the Association as they relate to the Annual meetings.
5. Responsible for all other requirements as outlined in the Constitution and By-Laws.

Recommendations relative to the responsibilities of the Editor were referred to the Journal Management Committee for further study.

Accepted the Journal Management Committee Report.

On the recommendation of the Journal Management Committee, the present Board of Associate Editors of the *Journal of Dairy Science* was discontinued, and a new editorial board of not more than 10 members was authorized.

Approved the appointment by the Editor of an Abstract Editor to replace the present Abstract Section Editors.

Accepted the Journal Management Committee's summary of the survey on the proposed new journal and decided, in view of the results, not to publish such a journal at this time but rather to expand the "People and Events" section.

Accepted the Membership Committee Report.

The Teacher-Award Committee Report was accepted as a progress report.

Accepted with thanks the offer of the Borden Company Foundation to provide two one-thousand dollar awards for 1954.

Elected C. W. Holdaway a Life Member of the Association.

Approved renewal of student affiliate branch certificates for the University of Missouri, University of Nebraska, Cornell University, Pennsylvania State College, Clemson College, Texas Technological College, and the State College of Washington.

Approved the issuance of new student affiliate branch certificates to the University of Maryland and Mississippi State College.

Elected K. L. Turk a member of the Journal Management Committee.

Accepted with thanks the offer of the American Feed Manufacturers' Association to present its one thousand dollar Feed Manufacturers' Award for each of the next three years.

Accepted the Report of the Representative of the National Research Council, and instructed the Secretary to investigate the matter of responsibilities, privileges, and cost of affiliate membership in the American Institute of Biological Sciences as was suggested in the report.

The report of the representative on the Ralston-Purina Research Fellowship Committee was accepted.

Named Dr. J. W. Pou as representative of this association on the Ralston-Purina Research Fellowship Committee for the period June 1953 through June 1956 inclusive.

Recommended that the practice of having the employment clearing house at each annual meeting be continued.

Voted to recommend that the American Dairy Science Association join the American Association for the Advancement of Science as an affiliate member.

Approved a budget for 1954 of $42,000.

Accepted the report of the Curriculum Committee as a reference report, and recommended that the present committee be dismissed with a vote of thanks.

Authorized the President to appoint a committee or committees to bring the Curriculum Committee Report into form for reproduction and distribution.

Approved the Resolutions Committee report.

Respectfully submitted, P. R. Ellsworth, *Secretary*.

Upon motion duly seconded, the report was accepted.

Upon motion, duly seconded, the Interim Action of the Executive Board during the past year was approved.

Results of the annual election were announced on June 15 as follows: Vice-President, L. A. Moore, Washington, D. C.; Directors, D. V. Josephson, Pennsylvania, and G. W. Salisbury, Illinois.

President Henderson announced that the 49th annual meeting would be held at Pennsylvania State College June 22-24, 1954.

NECROLOGY COMMITTEE REPORT

Members of the American Dairy Science Association deceased since the 1952 annual meeting include the following:

Harry Winfield Cave, Professor Emeritus, Department of Dairying, Oklahoma A & M College, died on June 23, 1953, following a prolonged illness. He was born in Fayette, Iowa, April 30, 1890. He was a former member of the Executive Board of the American Dairy Science Association and served as president of the Association in 1940-41.

Professor Cave did his undergraduate work at Iowa State College where he graduated in 1914. Two years later he received his master's degree at Kansas State College. He married Anita Lucille Meltzer, December 25, 1917. After serving a short time as fieldman for the Golden Valley Dairy Company, Kansas City, he was appointed assistant professor of dairy extension at West Virginia University in 1916. Two years later he joined the staff of Kansas State College as assistant professor of dairy husbandry, a position he held for two years. He was made associate professor in 1920 and professor in 1926, holding this rank until 1939. In this year he was appointed as professor of dairying and head of that department at Oklahoma A & M College. He held this position until poor health forced his retirement in 1950.

Professor Cave was a research fellow at Kansas State College, 1914-16, and an honorary fellow at the University of Wisconsin, 1930-31. While at Kansas State College, he coached four dairy cattle judging teams that won the national intercollegiate judging contest. He was an official type classifier for the American Jersey Cattle Club since 1942 and served the Holstein-Friesian Association as official judge.

The following are among the many organizations in which he held membership: Fellow AAAS, American Dairy Science Association, Phi Kappa Phi, Sigma Xi, and Sigma Phi Epsilon. He served as officer of several state breed organizations, and was an active member of the Stillwater Presbyterian Church, the Chamber of Commerce, the Lions Club and the Masonic Lodge. Professor Cave was noted for his energetic approach to dairy problems and for his thoroughness as a teacher and administrator. He was an avid sportsman with outstanding ability in golf and tennis. As a student at Iowa State College he lettered in track.

Author of many research publications and bulletins, Professor Cave's most notable publication was the development of the visible dairy herd book system in 1937 in collaboration with F. W. Atkeson.

He is survived by his wife, Anita; a daughter, Elizabeth Ann, and two sons, Douglas and Robert.

Carroll C. Flora, Associate Professor of Dairy Husbandry, Department of Dairy Husbandry, Virginia Polytechnic Institute, died May 20, 1953, in a Roanoke hospital after a brief illness.

At the time of his death he was Associate Professor of Dairy Manufacturing and Associate Research Dairy Husbandman at Virginia Polytechnic Institute. He was very closely associated with the dairy manufacturing industry in Virginia and active in civic, social and church affairs in his community. He was a member of A.A.A.S., A.D.S.A., Virginia Academy of Science, International Association of Milk Sanitarians, A.A.U.P., and the Lions Club.

He was 43 years old. He attended Bridgewater College, graduated from V.P.I. in Dairy Husbandry in 1933 and received his M.S. and Ph.D. from Penn State — the latter in 1938. After a brief period as plant supervisor at Martinsville Creamery, he was employed on the teaching and research staff of the Dairy Husbandry Department of V.P.I. He remained in this work until his death with the exception of two years in the Sanitary and Nutrition Division of the Army.

In his teaching work he was responsible for the dairy manufacturing work and the operation of the college milk plant. His contribu-

tions in research have largely been in the field of sanitary milk production.

Edwin Bret Hart, Emeritus Professor of Biochemistry, University of Wisconsin, died suddenly at his home March 12, 1953. He had served his university in many capacities over a period of 47 years. Born December 25, 1874, on a farm near Sandusky, Ohio, he was the youngest of a family of 12. His undergraduate work was done at the University of Michigan, where he received the B.S. degree in 1897. He early developed an interest in chemistry, especially analytical chemistry, and as an undergraduate was a special assistant to a distinguished professor of analytical chemistry, Dr. E. D. Campbell, who had lost his sight due to an explosion in the laboratory. His contact with Professor Campbell not only gave him early experience in teaching but also placed him in close contact with an investigator who emphasized accuracy in experimental work.

His first position was with the New York State Experiment Station at Geneva, where he came in contact with the director, Dr. W. H. Jordan, who stimulated Hart in much of his early experimental work. At the beginning of the century he went to Germany to study under the famous biochemist, Albrecht Kossel, who was then at Marburg. When Professor Kossel moved to Heidelberg, Professor Hart followed him and because of this transfer was prevented from obtaining a degree; but Professor Hart always felt that the right kind of training and experience were worth more than degrees. After two years in Germany he returned to Geneva, and in 1906 Dean Henry of the College of Agriculture invited him to come to the University of Wisconsin as head of the Department of Agricultural Chemistry and Chemist in the Experiment Station.

While at the New York Experiment Station, Professor Hart became interested in two subjects — the study of chemical changes in cheese during ripening and the importance of phosphorus compounds in plants and animals. Shortly after coming to Wisconsin he and his associates established the role of inorganic phosphorus in the nutrition of animals. A few years before Hart came to Wisconsin Dr. Babcock had initiated an experiment with growing heifers on rations derived from restricted sources. The results of these experiments had not been conclusive, and when Professor Hart arrived in 1906, Dr. Babcock presented the results of his preliminary work and suggested to Dean Henry that a more comprehensive experimental plan should be inaugurated. These studies led to publication of Research Bulletin No. 17, which has become a classical report since it laid the foundation for most of the modern research in nutrition.

It is interesting that very early in his career at the Agricultural Experiment Station two projects were outlined — namely, Adams No. 8, which dealt with mineral metabolism and mineral requirements of animals, and Adams No. 10, which dealt with vitamins and other organic nutrients in animal nutrition. It was typical of Professor Hart's philosophy to have a broad research program, one which was not confining but which allowed him to modify his approach as new ideas became available. No one individual has contributed more to research on minerals and vitamins in nutrition than Professor Hart. He was instrumental in the discovery that iodine is important in preventing goiter in animals and that copper and iron play important roles in hemoglobin building, and he was closely associated with much of the work in the Department of Biochemistry on 12 or more vitamins. He was author or co-author of nearly 400 scientific papers.

One of his most enjoyable and fruitful activities was his service on the Research Committee. He was a member of this committee for 19 years and gave much time and thought to its problems and responsibilities.

Professor Hart received many professional awards and honors, among which were the Borden Award from the American Dairy Science Association in 1941, election to the National Academy of Sciences in 1944, and the honorary degree of Doctor of Science, from the University in 1949.

In 1903 Professor Hart married Annie Virginia DeMille, who died June 28, 1936. One daughter, Margaret Hart Larson, survives.

His life was exceptionally rich in outstanding achievements and great leadership and in kindly inspiration to those who had the good fortune to know him.

Marshall C. Hervey, Associate Professor of Dairy Husbandry, Department of Dairy Husbandry, University of Minnesota, passed away January 25, 1953, at the University of Minnesota hospital.

Dr. Hervey was born May 30, 1913, on a farm in Ashtabula County, Ohio. His professional training was obtained at Ohio State University, where he received a Bachelor of Science degree in 1935, a Master of Science degree in 1936, and a Doctor of Philosophy degree in 1938. He was a brilliant student and maintained practically a straight "A" average through his undergraduate and graduate work.

From 1937 to 1942, Dr. Hervey was assistant and later associate professor of Animal Husbandry at the University of Tennessee. Soon after Pearl Harbor he joined the U. S. Navy and reached the rank of lieutenant in 1945. In 1946 he returned to his former position at the University of Tennessee where he was advanced to the rank of professor.

Dr. Hervey joined the staff of the Dairy Department at the University of Minnesota in 1949 with the rank of associate professor. His teaching was in the field of dairy cattle breeding and selection. His research work in the field of genetics involving a use of identical twins and triplets has attracted wide attention. Dr. Hervey was popular not only as a teacher on the campus but also as a speaker at meetings of farmers and livestock breeders.

Among the college honor organizations of which Dr. Hervey was a member are Alpha Zeta, Gamma Sigma Delta, Phi Eta Sigma, Phi Lambda Epsilon, and Phi Kappa Phi. He was also a member of the American Dairy Science Association, American Genetics Association, and American Society of Animal Production. In 1949-50 he was a member of the Technical Committee of the Regional Dairy Cattle Breeding Committee and last year served as chairman of the Executive Committee, North Central Regional Cooperative Research Project on Improvement of Dairy Cattle through Breeding.

Surviving are his wife, Dorothy Bishop Hervey; his three children, John, David, and Martha; his parents, Mr. and Mrs. J. D. Hervey of Falls Church, Virginia; two sisters, Mrs. Mary Johnston of Fayetteville, New York, and Sara Hervey of Philadelphia, Pennsylvania; and two brothers, Lawrence of Hartford, North Carolina, and Cameron of Chicago.

Egerton Gibson Hood, Head of Dairy Research for the Canada Department of Agriculture, died June 13, 1953, at Ottawa.

Dr. Hood received his M.S. degree from the Ontario Agricultural College with a major in bacteriology in 1913, and did his graduate work at Massachusetts Agricultural College from 1913 to 1918. He served in the Medical Corps, U.S. Army 1918-1919, later going to McGill University, where he served on the staff of the Bacteriology Department from 1920 to 1923. He received his Ph.D. from Massachusetts in 1922.

Appointed Head of Dairy Research for the Canada Department of Agriculture in December 1923, he remained in active charge until his death.

Dr. Hood's main work was on the bacteriological defects in butter and cheese, molds and yeasts in butter, surface taint in butter, discoloration and rancid flavors in cheese, activity of starters, and allied studies.

As a member of the American Dairy Science Association he served on the Committee on Methods for the Examination of Butter and Cheese. He was a Director of the Association 1937-39, member and Chairman (1952) of the Borden Manufacturing Award Committee. Dr. Hood received the Borden Award for outstanding research in dairy manufacturing in 1948.

Ernest Kelly, former Assistant to the Chief of the Bureau of Dairy Industry of the U.S. Department of Agriculture, died in Orlando, Florida, March 27, 1953 after a prolonged illness.

Mr. Kelly, an internationally known dairy scientist, was the senior author of a standard textbook on market milk and wrote many popular and technical bulletins on dairy problems.

He was born in Washington, D. C., in 1883 and completed his scientific training and education at Cornell University in 1906. Prior to entering the U. S. Department of Agriculture in 1910, he obtained experience in commercial dairies and in sanitary milk inspection as a State control official. He retired in 1946 after more than 35 years of government service, most of which was devoted to scientific studies relating to milk sanitation and to the development of production practices and educational programs for improving the wholesomeness of the nation's milk supply. He was instrumental in developing most of the research information that has been applied to the sanitary production of milk on the farm and in the factory.

In addition to serving as an official in various dairy associations, Mr. Kelly was a charter member and later president of the International Association of Milk Inspectors, now the International Association of Milk and Food Sanitarians. He is survived by his wife and two sons.

John B. Kitchen, Assistant Professor of Dairy Industry, Department of Dairy Industry, Rutgers University, died suddenly on December 4, 1952, as a result of a cerebral hemorrhage.

Professor Kitchen was born and raised on a farm in Salem County, New Jersey and attended the High School of Woodstown, New Jersey. He graduated from Rutgers University in 1939 as a major in Dairy Industry. After graduation from Rutgers he spent some time with the Federal Land Grant Bank at Springfield, Massachusetts in farm inspection and adjustments. A Sergeant during World War II,

he was stationed in England with the Medical Corps. After the war he became an instructor in Dairy Industry and did considerable research in grassland farming. He was responsible for a very important research project known as "The Milk Potentials of Roughage in the Feeding of Dairy Cattle." This project had been completed and he had just started another very important one entitled "The Milk Potentials of Grass Silage in a Dairy Ration." Professor Kitchen had been coach of the judging team at Rutgers University for the past five years. His work was recently mentioned in a speech by Secretary of Agriculture, Ezra Benson.

Martin Mortensen, Professor and former Head of the Department of Dairy Industry at Iowa State College, died March 13, 1953, at the home of his daughter, Mrs. Marie Beale, Houston, Texas, where he had been visiting.

Martin Mortensen was born May 29, 1872, at Sindai, Denmark. He attended public schools in Denmark and completed a three year course at the Royal Teachers Seminary. He taught in the public schools for one year before coming to the United States in 1893.

In 1894 he became buttermaker in a creamery at Iowa Center, Iowa, and remained there until 1897, when he entered Iowa State College. Three years later, in 1900, and before graduation he accepted the position of supervisor and manager of the Hanford Hazelwood Creamery at Sioux City, Iowa.

The company sold its Sioux City business in 1904 and Mortensen was employed by the firm as manager of the Hazelwood Creamery Company in Portland, Oregon, which became the largest creamery on the Pacific Coast. He held this position until 1908, when he was invited back to Iowa State College. He finished his degree of Bachelor of Science in Agriculture in time to accept appointment as head of the department of dairy industries on January 1, 1909. He served as head of the department until 1938, when the age limit compelled his retirement from administrative work. He was author of a text book, "Management of Dairy Plants," and also of bulletins on dairy research. He recently completed a manuscript on the history of dairying in Iowa. Professor Mortensen continued to teach in the department until a short time before his death on March 13, 1953.

Professor Mortensen was highly regarded by the dairy industry. He was a member of the American Dairy Science Association, which he served three years as secretary-treasurer, one year as vice-president, and one year as president. He was elected an Honorary Member of the Association for his services. He visited Denmark and other European countries as a member of the United States delegation to the World Dairy Congress in 1931, where he lectured on dairy topics.

He was a member of Sigma Xi, Phi Kappa Phi, Gamma Sigma Delta, Alpha Zeta, and Cardinal Key, Iowa State College men's honorary society. Professor Mortensen was made an honorary member of the Royal Agricultural Society of Denmark. In 1927 he was knighted by the King of Denmark to the Order of Ridder of Dannebrog and in 1950 received the Commander's Cross of the Order of Dannebrog.

He received the Chicago Merit Alumni Award for distinguished public service and the Iowa State College Faculty Citation awarded to outstanding members of the faculty. In 1934 he received an honorary L.L.D. degree from Kansas State College.

Professor Mortensen had a rare combination of talents. He was a successful buttermaker and manager, teacher, and scientist. He was held in high respect by all segments of the dairy industry. For over forty years he exerted a quiet, conservative, but very effective, influence over the industry. He served the state with distinction to himself and with great credit to the institution which he represented. Professor Mortensen will be remembered by his students and co-workers as a Christian gentleman endowed with natural dignity, poise, and friendliness.

Frank F. Rennie, Jr., Richmond, Va., died November 9, 1952. At the time of his death he was president of Virginia Dairy Company, Inc., Richmond, Va., and had been for about 30 years. He was twice president of the Virginia Dairy Products Association, 1931-32 and 1938-39, and was on the board of directors for many years.

Frank Rennie was the 16th president of the International Association of Milk Dealers, 1938-40. He was active in civic organizations, being Regional President of Rotary International.

In many ways he was an outstanding leader in dairy development.

Hugo Henry Sommer, Professor of Dairy and Food Industries, University of Wisconsin, died suddenly in Madison, May 8, 1953, at the age of fifty-six. He was born September 4, 1896, in Timothy, Wisconsin. He was the son of the late William Sommer and of Louise Sommer, who is still living. His parents were early residents of that area. He graduated from Sheboygan High School with honors. Between 1918 and 1922 he received his B.S., M.S., and Ph.D. degrees at the University of Wisconsin as a student in agricultural chemistry

under the supervision of the late E. B. Hart. Following the completion of his graduate work at the University he worked for a short period as a research chemist with the Northern California Milk Producers Association. He became affiliated with the Department of Dairy and Food Industries, University of Wisconsin, as Assistant Professor in 1920, was promoted to Associate Professor in 1925, and became Professor in 1928.

Brilliant student and investigator in the physics and chemistry of milk and milk products, Hugo Sommer became internationally famous for his scientific achievements in this field. Chief among his contributions were the isolation and identification of citric acid in milk, the influence of salts on the heat stability of evaporated milk, whereby was established the "salt balance theory" which has been applied to many heat-processed dairy products, studies on the creaming of milk, the development of desired properties in process cheese, the cataphoretic properties of milk fat, and the characteristics of ice cream.

Dr. Sommer was the author of numerous scientific bulletins and papers, and of two textbooks: *"The Theory and Practice of Ice Cream Making"* and *"Market Milk and Related Products."* These texts are outstanding in the treatment of physico-chemical aspects of the various products involved; both are standard texts in universities throughout this country and are used extensively in other countries. An outstanding teacher, his logic, clarity of expression, and incisive approach to fundamental problems in dairy chemistry attracted students to his classes from various colleges of the campus and from over the nation. Many of his students have found positions of responsibility in the universities of America as well as in the industrial field. He was a widely sought consultant on various technical matters and participated in the development of many unit processes now employed in the production of dairy products.

In 1942 he was recipient of the Borden Award presented by the American Dairy Science Association for outstanding achievement in Dairy Manufacturing research. In 1949 he was appointed a government representative of a delegation from the United States to the International Dairy Congress in Stockholm, Sweden. During the war years he was advisory member of the Price Administration Board at Washington.

He was a member of Luther Memorial Church of Madison. He was a member of Alpha Zeta, Gamma Alpha, Sigma Xi, Phi Lambda Epsilon, Delta Phi Epsilon, the American Chemical Society, the American Dairy Science Association, the International Association of Milk and Food Sanitarians, and the Wisconsin Dairy Technology Society.

In 1917 he was married to Miss Emma Hingiss. Survivors include his wife and two sons, David and Warren, his mother, and six grandchildren. Burial was held in Forest Hill, Madison.

Respectfully submitted, H. G. Lindquist; J. W. Stull; J. A. Tretsven; J. M. Jensen; K. M. Autrey, *Chairman.*

Upon motion duly seconded, the report was accepted and the President of the Association instructed to convey to the bereaved, by letter, the sympathy of the Association.

AWARDS PROGRAM THE AMERICAN DAIRY SCIENCE ASSOCIATION

The Association Awards presentation took place in the Theatre, Wisconsin Union Building, on Tuesday, June 23 at 7:30 P.M. President Henderson presided.

DeLAVAL EXTENSION DAIRYMAN AWARD

Lynn Copeland, member of the DeLaval Award Committee presented the winner.

"This award is based upon a minimum of ten years of Extension work and a valuable and noteworthy contribution to the dairy industry in his state. This contribution is determined by programs and projects initiated and developed, the extent of acceptance and application of projected new concepts and techniques, the effect on the dairy economy and farm people, and the qualities of leadership to get others to act.

"The man who has been selected as the 1953 recipient was born in Indiana and received his academic training at the University of California. After a period as farm and herd manager, he accepted an Agricultural Extension position as Assistant County Farm Advisor. In this position he displayed leadership in the dairy world by developing a county dairy herd improvement association embracing 7,500 cows. In 1924 he was appointed State Dairy Specialist where he developed a state-wide extension program in dairying that contributed greatly in achieving a state-wide goal to increase the average production of all dairy cows by one-half. The Extension Dairyman provided the leadership and direction of a dairy program including testing of large numbers of cows, changed feeding practices, and improved management methods that resulted in the achievement of the

goal as measured by BAE reports of the state showing that production per cow was increased by one-half in ten years.

"The nominee is a recognized judge of all the dairy breeds and has judged many major dairy shows. He has served as vice-chairman of the Extension Section of the American Dairy Science Association and was a member of the 1952-53 Feed Survey Committee of the American Feed Manufacturer's Association.

"His Extension program has kept his state in the lead for 25 years in the number of cows on DHIA test. He has been a leader in herd health activities, directed a dairy labor survey on 116 dairies to determine the relative efficieney of different types of milking operations, organized a state purebred dairy cattle association, and served on a state committee on Survey of Agricultural Productive Capacity.

"His 29 year's work in no small way has contributed to the fact that his state has the highest average milk production in the nation and was the first state for all cows to reach the average of 300 pounds butterfat per cow. (It was only 182 pounds in 1920.)

"He has prepared many excellent dairy publications, bulletins, and pamphlets, 150 subject matter articles for the press, and over 300 monthly newsletters on dairying.

"Although he has worked as the only Extension Dairyman in his state, his leadership, his training and direction of county agents in their dairy work, and his cooperative work with the dairy organizations of the state have enabled him to accomplish much and secure great results.

"On behalf of the Extension Dairyman Award Committee, it is a great pleasure to request Professor Gillette Eddy Gordon of California to come forward.

"Our committee presents as candidate for the DeLaval Achievement Award in Dairy Extension, Professor G. E. Gordon, of California."

Mr. C. B. Schmidt, President, DeLaval Separator Company, presented Professor Gordon with a check for $1000.00 and an inscribed, framed certificate.

G. E. GORDON

AMERICAN FEED MANUFACTURERS ASSOCIATION AWARD

Dr. J. T. Reid, Chairman of the Award Committee, spoke as follows:

"During each of the last six years the American Dairy Science Association has recognized outstanding contributions to dairy cattle nutrition by granting the American Feed Manufacturers Association Award to the person adjudged most worthy.

"Numerous findings of high value reported during the required period made the selection of the 1953 candidate a difficult task. Nevertheless, an evaluation of the reported research led to the selection of a series of investigations concerning the antirachitic activity of alfalfa hay and the vitamins D and A nutrition of young dairy cattle. In addition to their contribution to fundamental information, the results of these studies offer much promise of value to practical feeding. Other researches qualifying the author of these reports were those concerning molybdenum toxicosis in cattle, the effects of DDT-sprayed hay upon the health of calves and the influence of feeding thyroprotein upon health of the heart.

"The leader in these investigations was born and raised on a Jersey farm at Spanish Fork, Utah. He received the Bachelor of Science degree in Dairy Husbandry at the Utah State Agricultural College and, during one year, did advanced work in biochemistry at the University of Wisconsin. The candidate continued graduate study at Cornell University, from which institution the Doctor of Philosophy degree was conferred. Since 1946 he has been a member of the staff of the Nutrition and Physiology Division of the Bureau of Dairy Industry in the United States Department of Agriculture. The candidate is Dr. J. W. Thomas.

"On behalf of the award committee, it is my

J. W. THOMAS

F. E. NELSON

pleasure to present Dr. J. W. Thomas as the candidate of the American Dairy Science Association for the American Feed Manufacturers Association 1952 Award."

Mr. Wm. T. Diamond, Secretary-Treasurer of the American Feed Manufacturers Association, presented Dr. Thomas with a check for $1000.00.

BORDEN AWARD FOR DAIRY MANUFACTURING RESEARCH

Dr. H. L. Templeton, member of the Award Committee, made the following presentation speech.

"The person selected for the Borden Award in Dairy Manufacturing was born in Iowa in 1909. He took his undergraduate work in the Department of Agricultural Biochemistry at the University of Minnesota and also received the Degree of Master of Science in 1934 from the University of Minnesota, with a major in Dairy Bacteriology. The Degree of Doctor of Philosophy was obtained from Iowa State College in 1936, with a major in Dairy Bacteriology and a minor in Biological Chemistry. He held Fellowships at the University of Minnesota and the Iowa State College.

"He was Instructor in Dairy Bacteriology at the University of Minnesota, Assistant and Associate Professor at Kansas State College, and since 1943 has been Professor of Bacteriology at Iowa State College. Nineteen Ph.D. degrees have been granted for work done under his direction. He served for six years as Editor of the *Journal of Dairy Science*.

"The recipient is particularly noted for his work on the bacteriology of ice cream, molds in cream, lipolytic and proteolytic enzyme production by dairy microorganisms, use of lipases to hasten ripening of blue cheese made from pasteurized milk, and factors which influence bacteriophage multiplication in lactic cultures.

"It gives me great pleasure to present Professor Frank Eugene Nelson as recipient of the Borden Award in Dairy Manufacturing for the year 1953."

Mr. W. A .Wentworth, Secretary, The Borden Company Foundation, presented Professor Nelson with a check for $1000.00 and a gold Borden Award medal.

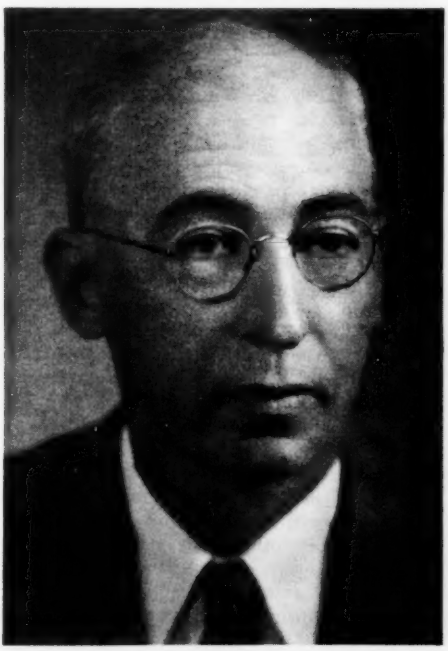
BORDEN AWARD FOR DAIRY PRODUCTION RESEARCH

Dr. J. C. Shaw, Chairman of the Borden Production Research Award Committee presented the award winner.

"The recipient of the 1953 Borden Award in Dairy Production chosen by the Borden Award Committee has been engaged in research and teaching for more than 30 years. He was born in Iowa in 1892. He received his B.S. degree from Iowa State College in 1916, his M.S. from that same institution in 1920, and his Ph.D. degree from the University of Minnesota in 1925. He has served as an assistant in Dairy Husbandry at Kansas State College, an Instructor at the University of Minnesota, an Associate Professor at Oklahoma A & M, and finally as Professor of Dairy Husbandry at the University of Florida, where he has been since 1929. He served in the U. S. Army during World War I.

"His important scientific contributions are many. Perhaps the contributions which have been most important are the extensive investigations relative to the mineral requirements of dairy cattle. It has been noted that during a period from 1927 to 1937 he reported on his mineral requirement studies in at least 13 journal articles and 9 experiment station publications. He was one of the first men to offer extensive information regarding the importance of cobalt for dairy cattle. The extent of his over-all contributions and activity in research is attested to by approximately 50 articles published in scientific journals, a like number presented via the experiment station and other state media and by at least 12 papers presented at the meetings of the Association of Southern Agricultural Workers. He has been instrumental in improving the agricultural economy of Florida and of the south in many ways. An example of his contributions in this line is his fine work which led to the extensive use of citrus by-products in dairy cattle rations. In 1952 he received a citation for outstanding contributions to dairying at the annual meeting of the Association of Southern Agricultural Workers. Much of his work during recent years has been the study of the functions and development of the calf's digestive tract. This is good evidence that in spite of an active past in the field he is continually alert for new approaches to the problems of dairy husbandry. He has taken a very active part in the activities of the American Dairy Science Association and in the Association of Southern Agricultural Workers. He has served for a number of years on the joint committee on Pasture Investigation Techniques. As a teacher, research worker and a gentleman, he has offered a great deal of inspiration to younger men in the field of dairy husbandry.

"On behalf of the Borden Award Committee in Dairy Production it is a pleasure to present Dr. Raymond Brown Becker to receive the award."



R. B. Becker

Mr. W. A. Wentworth, Secretary, The Borden Company Foundation, presented Dr. Becker with a check for $1,000.00 and a gold Borden Award medal.

ASSOCIATION HONORARY MEMBER AWARD

Dr. R. B. Becker, Honors Committee member, spoke as follows:

"For several years, the members of the American Dairy Science Association have nominated for Honorary Membership men whose labors in the service of the dairy industry have been outstanding. You have asked a committee composed of the three most recent past presidents to review your recommendations, evaluate accomplishments, and then to name your candidate for the highest honor of your Association. This has been done, and your candidate for 1953 is a man who long has rendered distinct and outstanding service. The Association's Honorary Membership for 1953 recognizes the many achievements, services and leadership which have been rendered by . . . Herbert Perry Davis.

"Professor Davis, the records state that

HERBERT PERRY DAVIS

your boyhood home was at Montague, Michigan. As did many others of your generation, you went early to the University of Missouri to study Dairy Husbandry under Professor Clarence Henry Eckles and graduated there in 1911. After a short interval on the University of Illinois Dairy staff, you moved onward as Assistant, and later Instructor, to Pennsylvania State College. You also earned a Master of Science degree from that good institution in 1914. Miss Esther Gertrude Greiner joined hands with you in 1915 as partner in your life work.

"The Dairy Division of the United States Department of Agriculture called you to serve as Assistant Dairy Husbandman, and later Dairy Husbandman and Editor, during which time several widely used dairy publications came from your pen.

"For three years you served as Professor of Dairy Husbandry and Vice-Director of the University of Idaho Agricultural Experiment Station.

"Since 1921, your activities have been claimed by the University of Nebraska at Lincoln, as teacher, investigator, author, and leader. Besides building and guiding a strong Dairy Department and teaching in the field of dairy husbandry, your published researches in management, nutrition, physiology, genetics and artificial breeding of dairy cattle have been recognized widely. You bred and developed an outstanding dairy herd of four breeds.

"Honors during this time were as an official delegate of the United States to the International Dairy Congress in Berlin in 1937 and corresponding member of the Italian Society for Progress of Science at Milan in 1948.

"You served the American Dairy Science Association in many capacities — as Chairman of the Official Testing Section, on many committees, the Executive Board, Vice-President, as President in 1943, and most recently as Chairman of the important Curriculum Committee. You have been active in professional, honorary, scholastic, civic, and religious organizations. For this outstanding leadership and service, the Association honors you for these accomplishments, and presents you with this inscribed Honorary Membership certificate as a token of distinguished service and its top Honors Award.

"We congratulate you, Professor Davis."

H. A. Bendixen; R. B. Becker; G. M. Trout, *Chairman.*

INSTALLATION OF OFFICERS

President Henderson installed the following officers-elect:

"D. V. Josephson and G. W. Salisbury, you were elected to the Board of Directors of The American Dairy Science Association. It will be your duty to pass on all applications for the establishment of divisions, sections and student branches of the Association. With the other members of the Board you will have full control of the budget and general business of the Association, hold title to all property and funds of the Association and have all the rights and powers vested in the Association by the laws of the District of Columbia. With these privileges, responsibilities and obligations you are now members of the Executive Board of The American Dairy Science Association to serve a term of three years.

"L. A. Moore, you are about to take over the responsibilities of Vice-President of the American Dairy Science Association. As Vice-President it will be your duty to preside over the Executive Board in the absence of the President and assume other duties of the Executive Board. At the expiration of President Price's term, you will automatically become President of this Association. I now charge you with these duties.

"W. V. Price, you are about to take over

the responsibilities of President of The American Dairy Science Association. As President it will be your duty to preside over the Executive Board and submit to the Board for approval nominations of members to fill vacancies that may occur among the elected officers of the Association. As President, you shall appoint the standing non-elective committees of the Association. With these obligations, privileges and responsibilities I now confer upon you the honor of being President of The American Dairy Science Association."

PEOPLE and EVENTS
in the Dairy Science World

Pioneers in the Dairy Industry

WILLIAM DODGE FROST, Emeritus Professor of Agricultural Bacteriology at the Univ. of Wisconsin, graduated from the Univ. of Minnesota in 1893 and was awarded his Ph.D. degree at the University of Wisconsin in 1903.

He was among the pioneer American bacteriologists. In 43 years of teaching, 1895-1938, more than 5,000 students attended his classes at Wisconsin. After retirement he devoted full time to his duties as superintendent of Morningside Sanatorium, a tuberculosis hospital which he helped found in 1909. He retired as president in 1952 after 43 years service on the board of directors but still serves in a consulting capacity.

As a dairy researcher, he invented the "Frost Little Plate" method for counting live bacteria in milk. He also devoted more than 15 years to studies of the hemolytic streptococci in milk. In 1938, he published a monograph entitled "The Streptococci, their description, classification, and distribution with special reference to those in milk." He was the first in this country to prepare desiccated media. During his university career, Dr. Frost published more than 90 scientific papers and wrote a number of textbooks.

Dr. Frost was one of the earliest workers in the field of antibiotics. In 1903, he wrote his doctor's thesis on the subject: "The Antagonism Exhibited by Certain Saprophytic Bacteria Against the Bacillus Typhosus Gaffke." He described seven different tests, most of which he devised himself, for demonstrating this action. He worked with organisms isolated from soil which he dug on the University campus.

DR. SELMAN WAKSMAN, 1952 Nobel prize winner for discovery of streptomycin, said, "The development of the field of antibiotics owes a great deal to the pioneering work of Dr. Frost, who laid the basis for our knowledge of specific substances produced by certain bacteria which inhibit the growth and destroy other bacteria."

In 1913, Dr. Frost was awarded the Doctor of Public Health degree at Harvard Medical School. His thesis was on bacteriological methods of analyzing milk. He also made a study of the bacteria in the butters of Boston.

As a young boy, Dr. Frost rode with his parents in a prairie schooner from his birthplace in Lake City, Minnesota, to the rolling prairie lands near the Dakota borders. He spent his boyhood and youth on a homestead farm where he plowed with oxen and "twisted" hay for stove fuel.

Dr. Frost lives with his wife at 1010 Grant Street, Madison, Wisconsin. He has two sons, six grandchildren, and two great grandchildren. THEODORE D. FROST is an educator in California. RUSSELL E. FROST is research director of the American Dairy Association, Chicago. Dr. Frost will celebrate his 86th birthday September 13.

A Paper Milk Container

A single service milk container called the Tetra Pak has been developed by the Tetra Pak Company of Lund, Sweden. The machine for forming this container was shown recently at the International Dairy Fair in Utrecht, Holland. The formation of the Tetra Pak container is based on the principle that a tetrahedrical package can be formed from a tube. The tube is pressed together in one direction and then again somewhat higher up at right angles to the first seal. In this manner a string of tetrahedrons (a polyhedron with four faces) is formed.

The paper used comes on a reel, printed on one side and coated with a thin plastic film on the other side. This film makes a waterproof package and makes possible heatsealing the tube into individual tetrahedrons. The machine forms the roll into a tube with the plastic on the inside.

The fluid to be packaged enters the paper tube from above through a stainless steel pipe. The surface of the milk is kept above the heat-sealing point at all times so that the packages are entirely filled. The volume of milk in the package is determined by the diameter of the tube-forming organ and the distance between two consecutive pairs of heat-sealing jaws. Little or no foaming takes place even when the machine is operated at high speed (up to 90 packages per minute).

The filled containers are packed in handle bags of paper or in square boxes. To remove milk from the Tetra Pak, one of the corners is cut or torn open. To reclose, the corner is folded over.

Judges Selected for International Dairy Show

Cattle experts from seven states have been assigned to judge the open class and junior

competitions at the International Dairy Show to be held Oct. 10 to 17 in the International Amphitheatre, Chicago.

S. M. SALISBURY of Ohio State University, will tie the ribbons on Ayrshires; GEORGE W. TRIMBERGER of Cornell University, will judge Brown Swiss; and L. O. COLEBANK, Univ. of Tennessee, will select winning Guernseys. Prize Holsteins will be chosen by PAUL B. MISNER of Langhorne, Pa.; Jerseys by GEORGE E. TAYLOR, New Brunswick, N. J.; and Milking Shorthorns by J. H. HUNTER of Geneseo, Kan.

On Junior Day, Monday, Oct. 21, three judges will select the winners in six breeds raised by boys and girls from 12 through 20 years of age. ARTHUR R. PORTER of Iowa State College, will judge Jerseys and Guernseys; HAROLD KAESER of Ohio State University, will judge Holsteins, Brown Swiss and Ayrshires; and W. F. ATKESON of Kansas State College will choose Milking Shorthorns in the Junior Show.

In the regular competition, Guernseys, Holsteins, and Jerseys will be judged on Oct. 13 and 14 and Ayrshires, Brown Swiss and Milking Shorthorns on Oct. 15 and 16.

A dairy cattle parade and rodeo will be held each day of the show.

University of Kentucky News

A fire of undetermined origin caused major damage to the dairy barn at the Univ. of Kentucky during the early morning of May 24. The entire loft and its contents, including a limited amount of feed and eleven experimental calves, were completely destroyed. Because of the protection afforded by the concrete slab floor under the loft, there was no significant damage done to the ground floor structure and its contents, which included calf and maternity stalls, judging arena, offices, laboratories, milking barn, milk room and cooler, and living quarters.

JOHN W. FOSTER, Field Agent in Dairying, resigned June 1 to manage the Collinwood Farm at Columbia City, Ind. Mr. Foster has purchased part interest in the operation. ELMER SCHEIDENHELM has been appointed to replace Foster and will join the staff on Aug. 1. Presently serving as county agent at Tuscola, Ill., Elmer has to his credit several years of experience in dairy extension work in Nebraska, Michigan and New Jersey.

JOHN COUEY, Field Agent in Dairying, resigned as of July 1 to accept a position as fieldman for American Breeders Service, Chicago, Ill.

LOUIS BOYD, Field Agent in Dairying, has resigned in order to continue advanced study leading to the doctor's degree. His services with U. K. will terminate Sept. 1, and his graduate work will be done at the Univ. of Illinois.

DURWARD OLDS, D.V.M., Associate Professor of Dairy Husbandry, will be on sabbatical leave beginning Sept. 11 and will attend the Univ. of Illinois, where he will study for the Ph.D. degree.

GARLAND BASTIN, formerly Dairy Herdsman, is now Field Agent in Dairying. JOE RUST, dairy husbandry major who graduated in June, has been appointed to fill the vacancy created by Bastin's transfer to the extension staff.

LIONEL A. RICHARDSON has accepted an appointment as Assistant in Dairy Manufacturing, Research. Mr. Richardson is a graduate from West Virginia Univ.

Minnesota Items

A major appointment at the Univ. of Minnesota was that of NED D. BAYLEY as Associate Professor of Dairy Husbandry, effective July 1. He will fill the vacancy left by the death in January of MARSHALL HERVEY. Dr. Bayley goes to Minnesota from the Univ. of Wisconsin, where he was Assistant Professor of Dairy Husbandry. He is a graduate of Michigan State College, received his master's degree from the Univ. of Minnesota, and obtained the Ph.D. degree from the Univ. of Wisconsin.

W. E. PETERSEN recently spent some time in Peru, South America, at the invitation of the National Department of Agriculture at Lima. Dr. Petersen left July 13 to spend a thirty-day period in lecturing to various groups in Peru.

JOHN DONKER, who has held an appointment as Research Fellow, has accepted an appointment at the University of Georgia, Athens, effective August 1.

New Staff Members at Rutgers University

EDWARD T. OLESKIE became Assistant Extension Specialist in Dairy Husbandry at the College of Agriculture, Rutgers Univ. in July. He received the B.S. degree in dairy husbandry from Rutgers in 1943. After serving in the Marine Corps he was employed as a herd tester, registration manager for the American Jersey Cattle Club, and general manager of Heep Farms and Ranches, Austin, Texas.

FRANK WRIGHT, formerly of the Univ. of Massachusetts Dairy Extension Service, has been appointed Assistant Professor of Dairy Husbandry at Rutgers Univ. Professor Wright is a graduate of the Univ. of New Hampshire, where he also obtained his M.S. degree, majoring in nutrition. He succeeds Professor JOHN KITCHEN, recently deceased, and will teach dairy farm management and cattle feeding. Some of his time will be devoted to research in the field of nutrition, and he will also serve as Assistant Superintendent of Official Testing in charge of field inspection.

News from Here and There

A cheese developed by the Wisconsin Alumni Research Foundation called "Nuworld" is being

listed in the Toledo, Ohio market. The new cheese contains a special enzyme that supposedly results in the development of an entirely different type of flavor. The cheese is pie-shaped and is packed in sizes that will retail for 47 to 53 cents each.

The Carnation Co. of Los Angeles has announced the appointment of RALPH R. BRUBAKER as vice president in charge of sales and advertising to succeed P. G. KINZER, who recently retired.

GLENN WHITTAKER, general manager of the Toledo, Ohio, Cloverleaf Dairy, has been elected vice-president.

J. B. MAY, comptroller of Southern Dairies at Roanoke, Va., has been elected a director of the corporation.

Senate bill S.1806, introduced by BARRY GOLDWATER (R., Ariz.) and JOHN C. STENNIS (D. Ala.), was set aside when called upon objection of Senator FRANCIS CASE (R., S.D.). The bill if passed would have authorized the serving of margarine by the Navy. At present both the Army and Air Force may serve margarine with meals but the Navy can use it only for cooking. The bill probably will be shelved for at least a year.

A. J. MARSCHALL, founder of the Marschall Dairy Laboratory, Inc., of Madison, Wis., recently died at his home at Winter Park, Fla. He was 88 years old. He was president of the company until 1944, when he became chairman of the board.

T. L. SEYMOUR-JONES, director of research of the New Products Laboratory of the Borden Co., died July 2. He was 57 years old.

R. W. BARTLETT, Dairy Marketing Specialist at the Univ. of Illinois, while testifying before a House Agriculture Committee, Washington, D. C., recommended replacing city and state milk inspection and control statutes which serve as trade barriers with federal milk marketing orders. He further recommended removal of trade association monopolies, by which he contends established dairies set margins and resale prices and prevent new distributors from entering the field with lower prices.

A. C. DAHLBERG has been appointed Advisor to the Board of Directors of the Dairy Products Improvement Institute. This position formerly was held by CARL W. LARSON, who retired July 1. DONALD H. RACE is the newly appointed Field Director. Mr. Race comes to his new position after two and a half years with the Pennsylvania Bureau of Milk Sanitation in Harrisburg. He graduated in 1951 from Pennsylvania State College, where he majored in dairy manufacturing. The offices of the Dairy Products Improvement Institute have been moved from Buffalo to Ithaca, New York.

Cache Valley, the dairy land of Utah, put on its first Annual Milk Festival June 27, 1953. The Cache Valley Dairy Cooperative, the Sego Milk, Carnation, and Borden companies, the Cache Valley Breeding Association, and the Chamber of Commerce planned the day's events. The world's largest ice cream cone, displayed on the public square at Logan, served 3,000 large cones to the youngsters and the two-mile parade and astounded the home folks from more than 20 communities. Twenty large floats lined the main street along with 80 truck displays and hundreds of decorated bicycles, baby carriages, and ponies.

Chairman of the event was PAUL BAUGHMAN of Carnation Milk Co., assisted by fieldmen CLAUDE QUINNEY of Carnation, ELVIN DENNIS of Sego Milk, WARREN POPPENSIEK of Borden, and WALLACE F. PARRISH of Cache Valley Dairy Cooperative. L. B. CAINE, president of Cache Valley Breeding Association, also was one of the leading figures. The Logan Herald Journal, which covers the entire Valley, put out a special Dairy Edition describing all phases of the dairy industry.

E. V. ELLINGTON, chairman of the Department of Dairy Husbandry, State College of Washington from 1922-1946, and since 1946, director of the Agricultural Extension Service, retired July 1. Professor Ellington has been active in community affairs over the years and currently is serving as chairman of the local draft board.

The second annual Dairy Day will be held by the Department of Dairy Science, Univ. of Illinois, Sept. 10. The program will feature exhibits and reports of research currently in progress in the department. The principal speaker will be ALLEN B. KLINE, president of the American Farm Bureau Federation.

A measure to prevent the sale of milk and milk products in paper containers in the state of Florida was defeated in committee session. The purpose of the proposed bill, according to its sponsor, was to make it possible for the purchaser to have a clear view of the contents of the container.

The National Dairy Products Corporation, Sheffield Co. Division, recently has introduced a new product called "Lo-Sol." This product, made from skimmilk which has had 95% of its sodium content removed, is especially suitable for low-salt diets and can be used in cooking, baking, on cereals, and in drinks.

Believes Butter Price Too High

R. W. BARTLETT of the Department of Agricultural Economics of the Univ. of Illinois, writing in the DPMA news for June, states that one reason for the decline in butter sales

is the continued relatively higher price for butter as compared with margarine. The retail price of butter from 1922 to 1926 averaged 82% more than the price of margarine. From 1927 to 1941 the butter price averaged 114% higher, and from 1947 to 1951 it averaged 121% higher. In 1952 retail butter prices were 195% higher than retail margarine prices. Bartlett raises a question as to the advisability of the government continuing to maintain butter prices at 90% of parity in view of the continued decline in per capita butter consumption.

Cherry-Burrell Announces New Case Washer

A catalog just issued by Cherry-Burrell Corp. describes the new 8" × 10" Case Washer which can be used to clean almost any type of box, case, or crate, with the open side either up or down. This double compartment washer, only 8 ft. long by 2 ft. wide, cleans 10 cases every minute and will fit into any power conveyor line.

Completed Theses

M.S. Degree:

DENNIS H. COX—The use of nordihydroguaiaretic acid to stabilize added vitamin A in fluid and dry milks. Univ. of Minnesota.

IVAN J. STERN—A technique for mass and enrichment culture of cellulolytic bovine rumen bacteria. Univ. of Illinois.

JOHN T. GODFREY—Crossbreeding in the West Virginia Artificial Breeders Cooperative, Inc. West Virginia Univ.

MISCHA E. FRIEDMAN—The nature of the proteolytic activity of *Bacterium linens*. Univ. of Illinois.

MYROSLOW PURKO—A study of the interrelationship between para-aminobenzoic acid and pantothenic acid in *Bacterium linens*. Univ. of Illinois.

Ph.D. Degree:

GEORGE CHRISTIANSON—Studies on some physical and chemical changes in milk in frozen storage. Univ. of Minnesota.

V. H. TOWNLEY—The use of a Venturi Atomizer in spray drier design. Univ. of Minnesota.

Trends in Dairy Sanitation through Cleaning-In-Place

A Guest Editorial

The program of cleaning certain dairy pipe lines and equipment in place (C.I.P) has gained momentum in recent years and gives promise of a real step forward in dairy sanitation. This program violates established tradition of daily dismantling, and in many instances necessitates a change in regulations to permit it. There is some resistance to change.

The secret of success of this method of cleaning is the use of a pump of sufficient capacity to insure a high velocity of circulation of rinse water, detergent solution and sterilizing agent. When properly carried out the results are often surprising, gratifying and dramatic. Visual inspection and swab tests of the contact surfaces commonly indicate a better job of cleaning and sterilizing than is accomplished by the conventional methods. As promising as these results may be, however, it is prudent to temper enthusiasm with judgment. It should be borne in mind that there is much yet to be done in redesigning some dairy equipment so as to adapt it to in-place-cleaning. With certain equipment, such as an ice cream freezer, it is necessary to dismantle in order to clean some contact surfaces not effectively cleaned by circulation. Leaks at the joints of pipe lines during the days operation permit solids to accumulate in the threads; these must be given special attention when lines are cleaned by circulation. There is conflicting opinion as to whether plate-type heat exchangers and homogenizers can be effectively cleaned in place. No doubt dairy engineers will design new equipment with in-place cleaning as a prime requisite of the future. It is a must, because it has already been demonstrated convincingly that better cleaning can be accomplished by prolonged high speed circulation of clear solutions than by momentary hand brushing of re-used solutions in a wash vat.

A. C. Fay

It is a fairly sound generalization that simplification of a difficult job inevitably gives good results more uniformly. C.I.P. is a good illustration of this principle. Adoption of C.I.P. should be based upon the expectation that it will give a better job of cleaning and sterilizing, not just because it is cheaper. With the present type of equipment it should be a fixed practice at first to disassemble equipment rather generally for inspection after the cleaning process and before the sterilization process, until experience dictates the places that need special attention. Satisfaction and pride in a job consistently well done with less effort is the best recommendation that can be given for C.I.P.

A. C. FAY
H. P. Hood & Sons

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ABSTRACTS OF LITERATURE

Prepared in cooperation with the
International Association of Ice Cream Manufacturers
and the Milk Industry Foundation

W. O. Nelson, Abstract Editor

ANIMAL DISEASES

500. Reviews of the progress of dairy science. Sec. F. Milk-borne diseases. J. Dairy Research, **20**, 1: 115-126. Feb., 1953.

The review is a survey of the recent literature dealing with milk-borne diseases; it covers the period from 1949 to date. There are 73 references. E. L. Thomas

501. Scientists throw light on X-disease. P. H. GROGGINS. Agr. and Food Chem., **1**, 5: 409. May, 1953.

Progress of research on the cause and prevention of X-disease (hyperkeratosis) of cattle is reviewed. Chlorinated naphthalenes, additives to lubricating grease for farm vehicles and feed production machinery, are a primary cause of the disease. A concerted effort is being made by manufacturers of lubricating greases to eliminate these additives from their products. Evidence to date indicates that pesticides are not involved in the X-disease problem. S. Patton

502. Hypocupremia in dairy cows. R. ALLCROFT and W. H. PARKER. Brit. J. Nutrition, **3**: 205-217. (Chem. Abstr., **47**: 5498i. 1953.) S. Patton

503. The development of chronic fluorine toxicosis and its effect on cattle. PAUL H. PHILLIPS, Univ. Wis., Madison. Proc. Natl. Air Pollution Symposium **2**: 117-21. 1952. (Chem. Abstr., **47**: 5549e. 1953.) S. Patton

BUTTER

504. Het Fritz-apparaat in de praktyk (The Fritz-machine in practice). H. RADEMA. Officieel Orgaan van de Koninkl. Ned. Zuivelbond F. N. Z., **45**, 10: 147-148. 1953.

The manufacture of butter with the Westfalia (Fritz) continuous buttermaking machine in two creameries in Holland is discussed. The control of the moisture content of the butter was one of the main problems encountered; usually it was too high. Lower moisture content could be obtained either by decreasing the speed of the two worms in the "working cylinder" or by increasing the flow of cream through the machine. The treatment which the cream received before "churning," such as cooling and temperature during ripening, affected the moisture content of the butter. Foaming of the cream should be prevented. The following data are presented for Aug.: % fat in cream, 46; past. temp., 92° C.; cooled to, 3° C.; % starter added, 4; ripening temp., 10° C.; cream at "churning," 9° C.; % fat in buttermilk, 0.8; amount of buttermilk, 40%; capacity, 500 kg. butter per hr. W. C. van der Zant

505. De continue boterbereiding III. Het Fritz-apparaat in de praktyk (Continuous buttermaking III. The Fritz-machine in practice). S. DYKSTRA. Officieel Orgaan van de Koninkl. Ned. Zuivelbond F. N. Z., **45**, 12: 182-183. 1953.

Butter produced with the Westfalia (Fritz) continuous buttermaking machine showed excellent keeping quality in cold storage. The somewhat greater air content of this butter did not affect the quality. The butter contained 225 γ iron and 35 γ copper per kg. W. C. van der Zant

506. Stability of vitamin A and carotene in butter made by different methods. MATTI ANTILA, KERTTU VUOLA, and PAAVO ROINE, Univ. Helsinki, Finland. Acta Agr. Scand. **2**: 210-214. 1952. (Chem. Abstr., **47**: 4515g. 1953.) S. Patton

507. Prevention of fishy taste in butter. Use of antioxidants. F. D. TOLLENAAR. Fette u. Seifen, **55**: 3-7. 1953. (Chem. Abstr., **47**: 4516b. 1953.) S. Patton

508. The induction period as an index of stability of butter. YA. ZAĬKOVSKIĬ, N. KOROBOVA, and L. RYABUSHKO. Molochnaya Prom., **14**, 2: 29-30. 1953. (Chem. Abstr., **47**: 5037d. 1953.) S. Patton

509. The chemical and physical characteristics of Danish butter. GIUSEPPE CERUTTI, Staz. sper. Freddo, Milan. Ann. sper. agrar.

(Rome) **7**: 189-192. 1953. English Summary. (Chem. Abstr., **47**: 5572e. 1953.) S. Patton

510. Composition of Mexican butter. Armando Ruiz and Rene O. Cravioto, Inst. nacl. nutriologia, México D.F., Ciencia (Mex.) **12**: 141-143. 1952. (Chem. Abstr., **47**: 5572f. 1953.) S. Patton

CHEESE

511. Manufacture of cream and Neufchatel cheese. E. Lundstedt. Sunny Brook Creamery, Inc., Miami, Fla. Milk Dealer, **42**, 8: 65-66, 129, 136. May, 1953.

The directions given for the manufacture of cream and Neufchatel cheeses include: (1) the theoretical limits of % of fat in mixes suitable for making legal cream and Neufchatel cheese, (2) combination of curd and cream for hot-pack cream cheese, (3) combination of whole milk curd and cream for hot-pack cream cheese, (4) factory record of hot-pack cream cheese, and (5) factory record of hot-pack Neufchatel cheese. Approximately 70 million lb. of cream cheese, including a small amount of Neufchatel cheese and hot-pack Neufchatel cheese spreads is produced annually. Production of these cheeses by milk dealers opens up a sizeable outlet for butterfat. C. J. Babcock

512. Cottage cheese . . . improved methods to assure high quality in this popular food product. R. J. Baker, S. D. Agr. Expt. Sta., Brookings. S. D. Farm & Home Research **4**, 3: 72-74. Spring, 1953.

Methods for producing high quality cottage cheese are discussed. Curd made from low solids milk is not firm enough to cut and cook in normal manner. Addition of 2% nonfat dry milk solids usually is sufficient to yield a cheese of satisfactory quality. The use of an electrometric pH measurement is recommended for determining the true acidity in cheese milk containing nonfat dry milk solids.
R. W. Hunt

513. Cheddar cheese study. Anonymous. Miss. Agr. Expt. Sta., State College. 65th Ann. Rpt., p. 24. July, 1953.

Samples of Minn., Wis., N. Y., and Miss. cheese were held 12 mo. Analyses show northern cheese was higher in butterfat but lower in protein. Ca, P, NaCl, water sol. N, heat coagulable N, peptone N, caseoses N, and amino N levels were approx. the same. The Miss. samples were firmer in body, and 3-6 mos. ripening usually was required to reduce the resistance of this cheese to the cutting time of northern cheese.
R. W. Hunt

514. Manufacture of soft surface cured cheese. J. H. Kraft (assignor to Kraft Foods Company). U. S. Patent 2,641,545. 6 claims. June 9, 1953. Official Gaz. U. S. Pat. Office, **671**, 2: 534. 1953.

A soft, surface-cured, mold-ripened cheese is covered with a mold pad lined with a porous fabric. R. Whitaker

515. Determining the titer of rennet. Wainer Salati, Industria lechera **34**: 399-401, 402-403. 1952. (Chem. Abstr., **47**: 5037a. 1953.) S. Patton

516. Effect of antibiotic residues in milk on cheesemaking. K. E. Thomé (Staten Mjeriförsök, Alnarp, Sweden). Svenska Mejeritidn., **45**: 13-17, 25-28. 1953. (Chem. Abstr., **47**: 5037b. 1953.) S. Patton

517. Aspects on cheese ripening with regard to taste and aroma. Torsten Storgårds. Svenska Mejeritidn., **45**: 37-40, 51-54. 1953. (Chem. Abstr., **47**: 5038a. 1953.) S. Patton

CONDENSED AND DRIED MILK; BY PRODUCTS

518. Removal of "chalky" flavor of dried milk a possibility. S. Patton and co-workers. Pa. Agr. Expt. Sta., State College. 65th Ann. Rpt., p. 11. July, 1952.

A significant limiting factor to the use of reconstituted dried milk as a beverage has been the undesirable feeling in the mouth. Removal of Ca ions by chemical means was observed to be a practical method of overcoming this tactual flavor defect. Low temperature processing resulted in a superior flavored product.
R. W. Hunt

519. Casein-lactic-acid composition. J. G. Kennedy and F. W. Bernhart (assignors to American Home Products Corp.). U. S. Patent 2,639,235. 6 claims. May 19, 1953. Official Gaz. U. S. Pat. Office, **670**, 3: 838. 1953.

A casein product which may be dispersed in milk to form a smooth creamy curd, consisting of 40 to 70% casein, 13 to 43% lactic acid, 0.2 to 0.9% sodium, and not over 3% moisture.
R. Whitaker

520. Use of whey (paste and powder) in the preparation of silage. H. v. d. Molen and D. Kapelle. Ned Weekblad Zuivelbereid. en Handel, **58**: 735-741. 1952. (Chem. Abstr., **47**: 5040c. 1953.) S. Patton

521. Concentrating milk. Geo. L. Cunningham (to Commonwealth Engineering Co., Ohio). U. S. 2,602,745, July 8, 1952. (Chem. Abstr., **47**: 5041c. 1953.) S. Patton

522. Stabilized milk products. Reginald E. Meade (to Western Condensing Co.). U. S. 2,627,463, Feb. 3, 1953. (Chem. Abstr., **47**: 5041d. 1953.) S. Patton

523. Food products from whey. ADRIAAN H. W. ATEN and SYBRANDUS G. WIECHERS (to Ned. Centrale Organisatie voor Toegepast-Natuurw. Onderzoek). U. S. 2,631,100, Mar. 10, 1953. (Chem. Abstr., **47**: 5041f. 1953.)

S. Patton

DAIRY BACTERIOLOGY

524. Time-temperature studies on the inactivation rate of Brucella abortus strain 2308 in milk. H. G. FOSTER, S. A. LEAR, and H. J. METZGER, Rutgers Univ., New Brunswick, N. J. J. Milk and Food Technol., **16**, 3: 116-120. May-June, 1953.

Brucella abortus (2308) was killed in 23 min. at 142.7° F. when the preheating time was zero and in 14 sec. at 161.6° F. When the preheating time was 60 sec., the test organism was destroyed in 23 min. at 142.7° F. and in 12 sec. at 161.6° F.

A negative phosphatase test as conducted by the N. Y. City Health Dept. laboratory would not insure the inactivation of *B. abortus* (2308). A negative test by Sanders and Sager's procedure shows that in the region of HTST pasteurization the test organism would be killed.

H. H. Weiser

525. Stopping mold with fungicidal paint. J. H. RICHARDSON and V. J. DEL GIUDICE, Research Div., Armour and Co., Chicago. Milk Dealer, **42**, 8: 64, 124-128. May, 1953.

The presence of mold growth is a hazard in dairy plants. It damages dairy products through digestion of protein, splitting of fats, and the breaking down of carbohydrates. Mold spores lodge in cracks in brick, plaster, and wooden walls. The most logical control method is the application of paint to these surfaces. Solubilized copper-8-quinolinolate was the most effective fungicide when incorporated in paints and other protective coating, such as sealers, laequers, and varnishes. Salicylanilide proved unsatisfactory; in higher concentration it was effective for only a week or so. Tetrachlorophenol and chlorophenol were effective but cannot be used because of their odors and/or government regulations. The slight pastel green color may be one of the oppositions that dairy people raise concerning solubilized copper-8-quinolinolate bactericidal paint.

C. J. Babcock

526. The occurrence and distribution of amino-acid decarboxylases within the genus Lactobacillus. A. W. RODWELL, Biochemical Laboratory, Cambridge. J. Gen. Microbiol., **8**, 2: 224-232. Apr., 1953.

The organisms tested were isolated from horse-stomach and sheep-rumen contents, the animals having been fed on diets rich in wheat. Histamine was formed apparently by organisms normally present in these animals and was detected in culture by means of guinea pig assay and chromatographic procedure. Several strains of lactobacilli which possessed decarboxylase activity on histidine, lysine and ornithine were isolated. Of 26 laboratory stock strains comprising 8 species of lactobacilli, only 1 strain of *L. pentoaceticus* and 1 strain of *L. bifidus* possessed amino acid decarboxylase attacking arginine, glutamic acid, or tyrosine.

J. J. Jezeski

527. A new procedure for bacterial viability counts and its biophysical applications. R. C. VALENTINE and J. R. G. BRADFIELD. Nature, **171**, 4359: 878. 1953.

Several types of bacteria, for example, strains of *Bacterium*, the *Chromobacterium* and *Pseudomonas*, but not cocci or filamentous organisms, respond to this method of differentiating and counting living and dead cells. The two types of cells are counted by means of an electron microscope using a random sample. The culture is first incubated for 3 hr. at 37° C. (6 hr. if irradiated) on a colloidion film supported by the microscope specimen grid, in petri dishes of nutrient agar containing 3% urea. The urea permits growth but inhibits cell division. The viable cells grow in size under this treatment and are easily distinguished from the smaller dead cells under the electron microscope.

R. Whitaker

528. Bacteriophage, a cause of starter failure in Georgia. F. W. BENNETT, Ga. Agr. Expt. Sta., Athens. Sou. Dairy Prod. J., **53**, 5: 178-182. May, 1953.

Bacteriophage was identified as a cause of starter failure in a commercial dairy plant in the Southeast for the first time. Phage from infected whey from a Georgia dairy plant destroyed in 3 hr. over 99.99% of the bacteria in sterile milk inoculated with 1% starter. Phage plaques were produced on plates inoculated with the infected whey.

F. W. Bennett

529. Enrichment and isolation of Streptococcus citrophilus van Beynum et Pette. A. KNETEMAN. Antonie van Leeuwenhoek, **18**, 4: 275-290. 1952.

Sludge from centrifuges used for the separation of raw milk was an excellent source of *S. citrophilus*. Inoculation of milk with some of this material followed by consecutive transfers (5 to 10) in milk at 30° C. led to an increase in number of this organism. Isolation was made on a special agar containing ferrocyanide, ferric citrate, and sodium citrate in such amounts that the formation of prussian blue just was inhibited. Decomposition of citrate by *S. citrophilus* imparted a deep blue color on the colonies.

W. C. van der Zant

530. Investigations on the biosynthesis of citrovorum factor by lactic acid bacteria. D.

HENDLIN, L. K. KODITSCHEK, and M. H. SOARS. J. Bacteriol., **65**, 4: 466-471. Apr., 1953.

Several lactobacilli synthesized citrovorum factor from pteroylglutamic acid. The factor was largely in the bound form which was available to *Leuconostoc citrovorum* only after enzyme digestion. *L. arabinosus* synthesized citrovorum factor from both p-aminobenzoic acid and pteroylglutamic acid. W. O. Nelson

531. The identity of "Leuconostoc citrovorum, strain 8081." E. A. FELTON and C. F. NIVEN, JR. J. Bacteriol., **65**, 4: 482-483. Apr., 1953.

Detailed examination of "*Leuconostoc citrovorum*, strain 8081" has revealed that this culture, which requires the citrovorum factor, is a typical strain of *Pediococcus cerevisiae*. Data are presented which suggest that the requirement for the citrovorum factor may be a unique characteristic of the genus *Pediococcus*.
W. O. Nelson

532. Rumen organisms. I. Curved rods and a related rod type. C. N. HUHTANEN and L. S. GALL. J. Bacteriol., **65**, 5: 548-553. May, 1953.

Nine types of rumen organisms were divided into 3 main groups based on morphology. All were nonsporeforming, obligate anaerobic rods which attacked fiber and produced propionic, butyric, acetic, and lactic acid as end products. The organisms were found repeatedly in large numbers in the rumen of adult animals. The taxonomic position of these organisms is not clear. It was postulated that they play an important role in roughage digestion in the ruminant. W. O. Nelson

533. Rumen organisms. II. Two lactate utilizers and six miscellaneous types. C. N. HUHTANEN and L. S. GALL. J. Bacteriol., **65**, 5: 554-559. May, 1953.

Eight types of rumen organisms were described, including 2 types which utilize lactate and 2 amylolytic types. The taxonomic position of the 8 types is not clear. W. O. Nelson

534. Calcium as a growth stimulant for Lactobacillus casei. C. H. EADES, JR. and M. WOMACK. J. Bacteriol., **65**, 3: 322-325. Mar., 1953.

Calcium, when added to an otherwise complete synthetic medium, stimulates the early growth of *L. casei* 7469. W. O. Nelson

535. Über das Eiweissabbau = u. Fettspaltungsvermögen einer Rhodotorula aus der Butter (Concerning the protein degradation and fat hydrolysis of a rhodotorula obtained from butter) English Summary. E. MIKLIK. Die Milchwissenschaft, **8**, 1: 23-26. Jan., 1953.

Rapid deterioration of butter in storage was caused by a yeast of the rhodotorula type. Both protein and fat were attacked. Maximum proteolysis took place at pH 5.8. Fat hydrolysis was enhanced in the presence of starter organisms and developed acidity.

Since butter samples examined failed to show coliforms but were high in *Sacrina lutea*, it was concluded that the yeast was an air-borne contaminant. I. Peters

536. Production of acetoin by Streptococcus diacetilactis. J. SUPIŃSKA-JAKUBOWSKA. Acta Microbiol. Polon., **1**, 151-170. 1952. (Chem. Abstr., **47**: 4428f. 1953.) S. Patton

537. The determination of antibiotic levels in blood and in milk following parenteral and intramammary injection. S. J. EDWARDS and MARY D. HASKINS. Comp. Pathol. Therap., **63**: 53-67. 1953. (Chem. Abstr., **47**: 4485h. 1953.) S. Patton

538. Methods of determination of coli-titer of milk. Z. SISHENENKO. Moloehnaya Prom. **14**, 2: 31. 1953. (Chem. Abstr., **47**: 5036c. 1953.) S. Patton

539. Effect of penicillin on Streptococcus diacetilactis. I. v. TIMROTH (Statens Mejeriförsök, Alnarp, Sweden). Svenska Mejeritidn., **45**: 61-62. 1953. (Chem. Abstr., **47**: 5037c. 1953.) S. Patton

540. Effect of nitrite and nitrate on butyric acid fermentation in cheese. KARL ERIK THURELL and GUNNAR SJOSTROM. Svenska Mejeritidin., **44**: 511-514, 523-526. 1952. (Chem. Abstr., **47**: 5037h. 1953.) S. Patton

DAIRY CHEMISTRY

541. A BDI detergent test for butterfat in milk and other dairy products. O. S. SAGER and G. P. SANDERS, Bur. of Dairy Ind., U.S.D.A. Sou. Dairy Prod. J., **53**, 4: 120-123, 129, 130, 132, 133, 140-142. Apr., 1953.

A new test for butterfat using noncorrosive chemicals and standard Babcock test equipment is described. The sample is prepared according to A.O.A.C. methods and the milk brought to 20° C. before sampling. Eighteen g. of milk is transferred by a pipette to the test bottle, 5.0 ml. of reagent "A" (7.0 g. sodium tetraphosphate and 3.0 g. Triton X-100 made up to 100 ml. with distilled water) added and the contents mixed by shaking. The bottle is set in a boiling water bath for 5 min., shaken and replaced in the bath for 10 min. more. The bottle is removed from the bath without remixing contents and 50% C.P. methyl alcohol added to top of graduated scale. Bottle is centrifuged for 2 min., transferred to a 55-60° C. water bath for 15 min. and then read in the usual manner. With minor modifications centrifuging may be omitted. Procedures are adaptable also to homogenized milk, cream, and Reddi-Wip. Accuracy of the test has not been extensively checked, but a limited number of

comparisons indicate close agreement with the Babcock and Roese-Gottlieb tests. A water-repellent silicone film on the inner surface of the neck of the bottle may flatten the lower meniscus. F. W. Bennett

542. Comparative properties of purified human and bovine prothrombin. W. H. SEEGERS and N. ALKJAERSIG, Wayne Univ. Coll. of Medicine, Detroit. Am. J. Physiol., **172**: 731-736. 1953.

Although human and bovine prothrombin are not similar in every respect, the preparation and properties, such as adsorption on barium carbonate, electrophoretic properties, autocatalytic activation and its inhibition, activation with thromboplastin, platelets, and calcium, and ultraviolet light absorption curves are identical. The less costly bovine prothrombin probably will be studied extensively for additional information on human physiology.
V. Hurst

543. Untersuchungen über die Käsereifung. I. Chromatographische Untersuchungen über das Vorkommen von Aminosäuren in verschiedenen Käsesorten. (Investigations of cheese ripening. I. Chromatographic investigations concerning the presence of free amino acids in different types of cheese.) English summary. I. STORGÅRDS and B. LINDQUIST. Die Milchwissenschaft, **8**, 1: 5-10. Jan., 1953.

By means of one-dimensional paper chromatography 200 samples of cheese comprising 11 varieties were examined for the presence of the various free amino acids. Varieties of cheeses examined included Hergårds, Svecia, Edam, Gouda, Cheddar, Emmenthal, Port Salut, Camembert, Edelkäse, Stilton, and Roquefort.

All samples showed the presence of free threonine, alanine, valine, methionine, leucine, lysine, and glutamic acid. Occasionally absent were aspartic acid, serine, glycine, and isoleucine. Usually present were alpha-aminobutyric acid, tyrosine, proline, tryptophane, arginine, histidine, tryamine, glutamine, asparagine, and phenylalanine. None of the samples showed the presence of free hydroxyproline or cystine.

The one-dimensional paper chromatography permits the simultaneous examination of 20 samples on one sheet of filter paper, whereas only one sample at a time can be examined by the two-dimensional method. The one-dimensional method is performed on buffered filter paper with the aid of 5 variously buffered solvents adjusted to desired pH levels.
I. Peters

544. Enzymatische Studien an Milchproteinen (Enzymatic studies of milk proteins.) English summary. A. LEMBKE, W. KAUFMANN, and HELGA SCHMIDT. Die Milchwissenschaft, **8**, 1: 10-16. Jan., 1953.

The increases of free tryptophane and tyrosine were used as measures of the activity of pure trypsin and pepsin upon milk variously treated. Spectrophotometrical measurements showed that both tyrosine and tryptophane had an absorption maximum at 2800 Å. Based upon the amount of tryptophane and tyrosine liberated under standard conditions, the activation energy of pepsin and trypsin in raw skimmilk was calculated to be 6,000 cal./mol.

Examination by chromatography showed that trypsin liberated tryptophane only, whereas pepsin liberated proline, hydroxyproline, and tyrosine from raw skimmilk. Boiled skimmilk was degraded more readily than was raw skimmilk with trypsin, whereas the opposite was true with pepsin. Irradiated skimmilk retarded the action of both enzymes. No noticeable differences were found in enzymatic degradation of skimmilk and whole milk with either of the two enzymes investigated. I. Peters

545. Further observations on the butyric acid method for the detection of milk fat adulteration. M. KEENY, Univ. of Md., College Park. Ice Cream Trade J., **49**, 5: 30, 88. May, 1953.

About 80% of 54 samples of ice cream collected from 19 manufacturers in Feb. contained 9.9 to 10.5% butyric acid with an average of 10.2%.

Iso-propyl alcohol can be substituted for absolute ethanol as a solvent for making the saponification medium as well as the alkali for titrating the chromatographed acids. Directions for making the saponification reagent and alkali solution for titrating the fractions from the chromatographic column are given. A refinement has been made in the original formula for calculating adulterations.
W. H. Martin

546. Lactose. GÜNTHER MALYOTH and HANS W. STEIN, Univ. Munich, Ger. Klin. Wochschr., **31**, 36-38. 1953. (Chem. Abstr., **47**: 4386f. 1953.) S. Patton

547. Determination of total fat, milk fat, and coconut oil in chocolate products. H. HADORN and R. JUNGKUNZ. Rev. intern. chocolat., **7**, 289-301. 1952. (Chem. Abstr., **47**: 4518b. 1953.) S. Patton

548. Potassium dichromate and boric acid as preservatives for milk samples shipped for the determination of (the presence of) tubercle bacilli. K. H. WEGENER. Lebensmitteltierarzt, **3**, 107-108. 1952. (Chem. Abstr., **47**: 4514i. 1953.) S. Patton

549. Separation by acetone precipitation of two constituents of lactenin (from skimmilk). J. E. AUCLAIR and N. J. BERRIDGE. Biochem. et Biophys. Acta **10**: 196-197. 1953. (Chem. Abstr., **47**: 4409c. 1953.) S. Patton

550. The acid phosphomonoesterase in the milk of cows, goats, and sheep. ENRIQUE

CASTELLÁ BERTRÁN. Anales fac. vet. univ. Madrid y inst. invest. vet., **4**: 360-367. 1952. (Chem. Abstr., **47**: 4453i. 1953.) S. Patton

551. Plasteins obtained from enzymic and acidic hydrolyzates of casein preparations. K. S. MAKAROV, State Med. Inst., Yaroslavl. Doklady Akad. Nauk S.S.S.R., **87**: 975-978. 1952. (Chem. Abstr., **47**: 5466d. 1953.) S. Patton

552. Paper chromatographic investigations of human, bovine, and rat milk. G. MALYOTH, H. W. STEIN, E. HÖRMANN, and R. SCHULER, Univ. Kinderklinik, Munich, Ger. Experientia, **9**: 70-71. 1953. (in German.) (Chem. Abstr., **47**: 5500b. 1953.) S. Patton

553. Composition of milk. Carbonic anhydrase, rhodanese, and alkaline phosphomonoesterase in milk of cows, goats, and sheep. CRISTINO GARCÍA ALFONSO and ENRIQUE CASTELLÁ BERTRÁN. Anales fac. vet. univ. Madrid y inst. invest. vet., **4**: 3-11. 1952. (Chem. Abstr., **47**: 5523d. 1953.) S. Patton

554. Rennin and its action on milk casein. VI. Phosphatase activity of rennin. H. MATTENHEIMER, Hs. NITSCHMANN, and P. ZAHLER, Univ. Bern, Switz. Helv. Chim. Acta, **35**: 1970-1983. 1952. (in German.) (Chem. Abstr., **47**: 5570i. 1953.) S. Patton

555. The effect of freezing on the stability of the lecithin of milk. P. L. FARFALETTI-CASALI and G. CERUTTI, Staz. sper. Freddo, Milan. Ann. sper. agrar. (Rome), **7**: 193-196. 1953. (English summary.) (Chem. Abstr., **47**: 5571b. 1953.) S. Patton

556. Amino acid content of a dialyzed enzymatic casein hydrolyzate. K. ARVID J. WRETLIND, Karolinska Inst., Stockholm. Acta Physiol. Scand., **27**, 189-203. 1953. (Chem. Abstr., **47**: 4930e. 1953.) S. Patton

557. Humpback oil and the milk and milk fat from the sperm whale. TORBJØRN PEDERSEN. Norweg. Whaling Gaz., **7**: 375-378. 1952. (Chem. Abstr., **47**: 4989e. 1953.) S. Patton

558. Evaluation of method of rapid determination of the amount of protein in milk. L. KARUNINA and M. SHILOVICH. Molochnaya Prom., **14**, 2: 25-28. 1953. (Chem. Abstr., **47**: 5036d. 1953.) S. Patton

559. Determination of fat in chana (cheese) by the Gerber milk butyrometer. S. N. MITRA. Science and Culture (India), **18**: 150-151. 1952. (Chem. Abstr., **47**: 5037f. 1953.) S. Patton

DAIRY ENGINEERING

560. Is the steam pump the answer? C. W. KAIN, Worthington Corp., Harrison, N. J. Milk Dealer, **42**, 8: 57-58. May, 1953.

The steam pump is so flexible that the capacity and pressure can be varied over a wide range while the efficiency remains relatively constant. The discharge pressure can be varied without a change in capacity, and the capacity can be varied without a change in pressure, by changing the position of the steam inlet valve manually or by automatic controls. The pump handles liquids of high viscosity with little extra power required. If steam is available, this pump is a low cost and useful spare in case of electrical power failure. C. J. Babcock

561. Refrigerating dairy trucks with water ice. Anonymous. Milk Dealer, **42**, 8: 59, 145-146. May, 1953.

Ice refrigeration conveniently provides quick chilling at low cost. Its economies are low initial outlay and freedom from maintenance, repair, and replacement costs. One system, used mainly in large, long distance trucks, makes use of a compartment or bunker filled with ice at the front of the cargo area. A blower circulates cold air from the ice over the cargo. An alternate system entails the installation of a nonmechanical, ice-using air conditioner ranging in capacity from 150 to 450 lb. of ice in front of the cargo space. Efficient cooling for insulated truck bodies up to 700 cu. ft. is provided. Warm air rises within the body into an intake vent mounted near the ceiling, down a duct and over the ice, which cools and washes the air. It then goes out an exit near the floor and flows around the cargo, rising again when it becomes warm. A small electric motor to provide the draw at the top vent is the only moving part of the unit. C. J. Babcock

562. Canning process. C. O. BALL. U. S. Patent 2,639,991. 22 claims. May 26, 1953. Official Gaz. U. S. Pat. Office, **670**, 4: 1117. 1953.

A process for high-temperature, short-time bulk sterilization of liquid low acid food products and aseptic canning. Filling of the sterilized hot product into cans is accomplished under positive pressure to prevent boiling, the lid is loosely attached, the pressure reduced to generate some steam and then the can is permanently closed. R. Whitaker

563. Hydrogen ion concentration adjustment. R. ROBICHAUX. U. S. Patent 2,638,419. 24 claims. May 12, 1953. Official Gaz. U. S. Pat. Office, **670**, 2: 531. 1953.

A process is described for neutralizing or adjusting the pH of milk, cream, ice cream mix, and other dairy products continuously. The required alkali solution is metered automatically

into the inlet pipe of a vacuum vessel, where the product and alkali are thoroughly mixed and neutralization is accomplished under reduced pressure. When the product reaches the desired pH, it is withdrawn from the vacuum chamber continuously. R. Whitaker

564. Machine for dating and applying closures to bottles. W. E. ZIMMERMANN (assignor to Standard Packaging Corp.). U. S. Patent 2,639,850. 9 claims. May 26, 1953. Official Gaz. U. S. Pat. Office, **670**, 4: 1077. 1953.

A vacuum closing machine of the rotary type which dates and applies a preformed closure to milk bottles. R. Whitaker

565. Valve. W. J. HABGOOD. U. S. Patent 2,640,676. 4 claims. June 2, 1953. Official Gaz. U. S. Pat. Office, **671**, 1: 209. 1953.

A sanitary type plug valve, the valve proper being retained in the valve casing by magnetic force acting between the bottom of plug and the bottom of the casing. R. Whitaker

566. Plate heat exchanger. R. P. L. HYTTE (assignor to Aktiebolaget Separator). U. S. Patent 2,640,194. 10 claims. May 26, 1953. Official Gaz. U. S. Pat. Office, **670**, 4: 1167. 1953.

A design for a heat exchanger in which the flow of liquid is passed between corrugated plates so that turbulent flow is promoted. R. Whitaker

567. Dispenser. P. MARTIN (assignor to Foster's Freeze National Corp.). U. S. Patent 2,639,678. 11 claims. May 26, 1953. Official Gaz. U. S. Pat. Office, **670**, 4: 1028. 1953.

Soft ice cream or similar product is flavored with a liquid flavoring material in this dispenser, consisting of a hollow plug type valve which is attached to the freezer outlet. When the valve turned in a certain position, frozen mix and the flavoring material are forced into the valve simultaneously. The flavored product is discharged into a cup or cone by turning the valve to another position. R. Whitaker

568. Plate apparatus and press. B. G. NEWHALL (assignor to Cherry-Burrell Corp.). U. S. Patent 2,639,126. 13 claims. May 19, 1953. Official Gaz. U. S. Pat. Office, **670**, 3: 808. 1953.

Structural details are given for a plate-type of milk heater, cooler, or regenerator. R. Whitaker

569. Refrigerated truck transport problems. W. H. REIDT. Refrig. Eng., **61**, 5: 514-518. May, 1953.

The common source of refrigeration are water ice, dry ice, and mechanical refrigeration. Water ice is used in bunkers with air circulation or as crushed ice blown over the load or packed in individual containers. Dry ice sometimes is placed on top of frozen food loads or in containers attached to ceiling or walls. Dry ice may be placed in bunkers with finned outer surfaces and air circulated over them by means of a fan. A newer development uses dry ice and a secondary refrigerant circulated through finned coils attached to the ceiling. For frozen foods the most common source of truck refrigeration is the mechanical system. Refrigeration is accomplished by means of cold plates, finned coils, or forced air circulation from the cooling unit.

Regardless of system used, air is the transfer medium between the commodity and the refrigerated surface hence provision must be made for complete air contact with points of heat pickup. Pre-cooling to carrying temperature is desirable. L. M. Dorsey

570. Modern trends in air distribution. R. D. TUTT. Refrig. Eng., **61**, 5: 509. May, 1953.

The 3 basic systems which eventually will come into general use for air distribution in air conditioning systems are:

(1) The conventional low pressure system in which main duct velocities for general commercial installation do not exceed 2000 f.p.m. with branch ducts having a velocity not to exceed perhaps 1500 f.p.m.

(2) A medium pressure system in which the main duct velocities do not exceed 4000 f.p.m. and the branch duct velocities do not exceed 2500 f.p.m., and where the static pressures do not attain a maximum value of more than 3 in. H_2O.

(3) The high pressure system in which duct velocities up to 9000 f.p.m. or 10,000 f.p.m. with branch velocities at 3000 or 4000 f.p.m. are used, where maximum static pressure may be 6 to 8 in. H_2O.

The high pressure system employing silencers because of a discharge noise level of about 90 decibels from high fan tip speed, and ceiling diffusers makes for economy of installation in duct size and the use of metal or glass fiber flexible conduits. L. M. Dorsey

DAIRY PLANT MANAGEMENT AND ECONOMICS

571. Let's look at the equipment picture. H. F. JUDKINS, Nat'l Dairy Prod. Co., Inc. Sou. Dairy Prod. J., **53**, 5:25-27, 30-32. May, 1953.

Some of the important trends in the dairy industry since 1910 are a 25% increase in milk production per cow, an increase of 16% in numbers of cows, larger herds, more grassland farming, better building layout, machine milking, farm tank pickup system, less man hours per cow, more even annual milk production, a 50% reduction in per capita consumption of butter, a corresponding increase in consumption of margarine, the introduction of vegetable fat frozen products, a 30-40% increase in per capita consumption of cheese in 15 yrs., increased consumption of nonfat dairy products,

canned sterile fresh milk, concentrated milk, less frequent deliveries of milk, increased milk delivery through stores, use of paper bottles, 6 or 5-d. per wk. operation of plants, C.I.P. pipelines and equipment, and single story plants. These trends will influence types of equipment in the future. Important factors to consider in the manufacture and selling of equipment are sanitation, ease of maintenance, materials used, power requirements, capacity as related to needs, safety, possible profits to purchaser, and proper installation and operating instructions.

Some of the industry needs are a cheaper single service milk bottle, a uniform ideal case for paper milk bottles, improved casers and decasers for bottles, better refrigeration for delivery trucks, improved methods and equipment for making cottage cheese, an improved meter for fluid dairy products, automatic filling and weight control equipment for bulk ice cream, practical equipment for small ice cream plants, improved methods of continuous hardening of small ice cream packages, better equipment for individual service of ice cream, easily dispersible milk powders, improved HTST pasteurizers, better concentrated milk, inexpensive test for fat and solids-not-fat, less expensive satisfactory materials for handling milk, better milk can fillers, and more mechanization of ice cream novelty operations.

More men trained in both dairying and engineering are needed to accomplish the desired results. F. W. Bennett

572. Dairy industry prepares to answer Benson's challenge. Anonymous. Agr. and Food Chem., **1**, 5: 354-355. May, 1953.

Secretary Benson's analysis of problems facing the dairy industry and steps which the industry is planning to take toward their solution are discussed. As a tangible response, the dairy industry is spending more money on consumer advertising than ever before. S. Patton

573. Cutting your labor cost. Anonymous. Ice Cream Rev., **36**, 11: 64, 65, 78, 79. June, 1953.

A specially designed portable conveyor which extends from the continuous freezer into the hardening room and returns has enabled Tom Cooper Farms at Ardmore to produce premolded ice cream cones, ice cream sandwiches, or ice cream slices directly from a 150 gal. per hr. continuous freezer with a marked reduction in labor cost.

Under the previous method of operation 300 doz. ice cream cones were produced per d. with a crew of 4. The present operation enables the plant to produce 225 doz. prefilled cones or sandwiches per hr. with a crew of 5. Careful checks have shown a saving of 50% in man hours in the production of premolded ice cream cones, and 55 to 56% saving in man hr. in the production of sandwiches. In addition there is a considerable saving in refrigeration, since traffic in and out of the hardening room is reduced. W. J. Caulfield

574. Improved equipment cuts dairy products building maintenance hazards. E. J. Clary. Am. Dairy Prod. Rev., **15**, 5: 12-15. May, 1953.

With the increasing size of dairy industry buildings and the installation of modern appliances, there is an increase in the accident rate arising from "off-floor" maintenance. Involved are such operations as cleaning windows and interior glass, lighting maintenance, walls, general cleaning, painting, sign and marker work, and property repair work. Seventy-five % of maintenance accidents are the result of makeshift scaffolding, with the remainder largely due to worker carelessness. Modern scaffolding has been designed to reduce accidents and increase efficiency. Its many features make it adaptable to a variety of uses. T. J. Claydon

575. The behavior of marketing margins on dairy products. R. W. Bartlett, Univ. of Ill., Urbana. Milk Dealer, **42**, 8: 96-105. May, 1953.

The consumer's food dollar may be divided into that received by the farmer and that going for receiving, processing, packaging, warehousing, transportation, and distribution. From 1929 to 1951, farmers received 44¢ and distribution 56¢ of the food dollar. The distribution share for butter was 29¢; for American cheese, 45¢; for evaporated milk, 59¢; and for market milk for home delivery, 51¢, and for that purchased at stores, 46¢. The data show: (1) proportions of the food dollar consumed by distribution margins, (2) indexes of changes in the wholesale prices of all commodities, market basket margins, and distribution margins of specific dairy products, (3) retail store price, wholesale price, price to farmer, and manufacturing and store margins per 14.5 oz. can of evaporated milk in 48 markets—1919, 1929, 1939, and 1951, (4) cost of distributing milk to consumers through stores as measured by dealers' gross handling margins in 24 cities with populations of 300,000 or over, 1929, 1939, 1949, and 1951. It is suggested that, in order to lower unit costs of operation, the dairy industry encourage: (1) the integration of plants manufacturing dairy products and those processing milk, (2) the elimination of consumer price fixing in states which still have this form of control and (3) intermarket shipments of milk, reduction of store prices at least 2¢ a qt. below home delivered prices in milk markets which now have no differential, and wider use of quality discounts. C. J. Babcock

576. Modernized billing. D. H. Bennett, Oakhurst Dairy, Portland, Me. Milk Plant Monthly, **42**, 5: 22, 23. May, 1953.

The Oakhurst Dairy, handling over 3,000 monthly accounts, obtained an efficient billing

system by installing microfilm. The route book slip was changed slightly to make it adaptable for billing. The items for each account are totaled, the amount due is placed on the slip, and the route salesman's original record becomes the customer's bill. The amount due for the current month is posted to a monthly account card retained in the office. The slips are arranged alphabetically by route, microfilmed, and returned to the salesmen, who distribute them to their customers. The main advantage to the customer is that she can see not only the total amount of the products purchased but also the amount purchased each day of delivery. This virtually eliminates calls to the office for clarifying bills. Bills are ready for distribution approximately 2 d. earlier than they were prior to microfilming. It is estimated that microfilming equipment saves at least $50 per mo. A customer's bill is illustrated.
C. J. Babcock

FEEDS AND FEEDING

577. Ammoniated by-products replace high protein feeds. C. B. Knodt, Pa. Agr. Expt. Sta., State College. 65th Ann. Rpt., p. 8. July, 1952.

Feeding trials with dairy cows have shown that ammoniated by-products may be substituted for some of the high protein concentrate now used in grain rations. Blackstrap, citrus solubles, distillers' molasses, and the like have been waste products of the industry. Tests have revealed no appreciable difference in rumen bacteria or protozoa between cows fed ammoniated by-products and cows fed practical grain rations. R. W. Hunt

578. Minerals for dairy and beef cattle. R. B. Becker, P. T. Dix Arnold, W. G. Kirk, G. K. Davis, and R. W. Kidder. Fla. Agr. Expt. Sta., Gainesville. Bull. 513. Feb., 1953.

Mineral consumption, symptoms of mineral deficiencies with pictures of diseased animals, relation of copper and molybdenum to cattle nutrition, and recommended mineral mixtures are presented. R. W. Hunt

579. Self-feeding grass silage from the stack. C. Wilson and O. Olson. S. D. Agr. Expt. Sta., Brookings. S. D. Farm & Home Research, **4**, 3: 66-71. Spring, 1953.

A rectangular stack of 120 T. of bromegrass and alfalfa silage approx. 60 ft. long, 24 ft. wide at the base, with a depth of 10 ft. at the crown was bounded by a snow fence with 2 portable feeding panels. This silage was self-fed during the late summer and early fall to 50 milking cows. When the stack was half fed, samples were taken for chemical analysis. No preservatives were added, even though the moisture content at the time of stacking was 58%. A layer of mold developed, ranging from 6 in. on the top of the stack to 12-18 in. on the side. This portion was readily consumed with no scouring or digestive disturbance. Analyses indicated that moisture content remained satisfactory although there was a variation between the sides and bottom; crude protein was silghtly higher than fresh grass except in the moldy layer; ether extract portion was lower in all samples; mineral losses were observed from bottom material but a slight increase was noted in the moldy portion (probably due to losses in other material); carotene losses were nearly complete, and acidity increased except in the moldy layer. R. W. Hunt

GENETICS AND BREEDING

580. Inflammatory response of the bovine endometrium. W. G. Black, L. C. Ulberg, H. E. Kidder, J. Simon, S. H. McNutt, and L. E. Casida. Wis. Agr. Expt. Sta., Madison. Am. J. Vet. Research, **14**, 51: 179-183. Apr., 1953.

Since previous experiments with laboratory animals had indicated that estrous uteri were not as easily infected as luteal phase uteri, the same comparison was made with virgin heifers. Egg yolk-citrate diluted bovine semen containing sulfonamides and antibiotics was injected directly into the uteri of 3 heifers in heat and of 3 heifers 12 d. after heat. None of the heifers injected while in heat showed a gross response at slaughter 36 hr. later. Pus was found in 2 of those injected in the luteal phase. Six mature cows which had failed to conceive after repeated services gave variable reactions to inseminations 8 to 12 d. after heat. Two gave no response, 1 was doubtful, and 3 had pus in utero 36 hr. after insemination. When 4 virgin heifers and 4 repeat breeder cows were inseminated with the same semen simultaneously 7-14 d. after heat, all of the heifers showed uterine congestion or pus, but only 1 of the cows gave even a doubtful response. Histological studies of these uteri showed an acute endometritis in the heifers and a suggestion of a chronic-type reaction in the cows. The possible endocrine effects upon uterine infections in cows are discussed. E. W. Swanson

HERD MANAGEMENT

581. Barn cleaner. D. W. Garnett (assignor to Thomas F. Keegan). U. S. Patent 2,635,737. 3 claims. Apr. 21, 1953. Official Gaz. U. S. Pat. Office, **669**, 3: 804. 1953.

Material in the gutter behind cows in stanchions is moved to the end of the gutter by a conveyor having a reciprocating motion.
R. Whitaker

582. Teat cot. G. L. Wright. U. S. Patent 2,636,492. 2 claims. Apr. 28, 1953. Official Gaz. U. S. Pat. Office, **669**, 4: 1101. 1953.

A cot for protecting teats of cows is made of an elastic gauze material, tubular in shape and with a hem and an endless elastic drawstring at the lower end. R. Whitaker

583. Valve for milking systems. R. E. Reeve. U. S. Patent 2,640,497. 4 claims. June 2, 1953. Official Gaz. U. S. Pat. Office, **671**, 1: 158. 1953.

A plug type valve for use with a milking machine hose, with a bracket and adjusting screw for holding the valve in place in the valve casing. R. Whitaker

584. Control mechanism for milking systems. L. Van der Plate. U. S. Patent 2,641,223. 3 claims. June 9, 1953. Official Gaz. U. S. Pat. Office, **671**, 2: 444. 1953.

A time actuated valve in the vacuum line, coupled to a piston operating in a cylinder, provides a pulsating action on the teat cups of this milking machine system. R. Whitaker

585. Spreader for milk can filling means. G. R. Duncan (assignor to Zero Mfg. Co.). U. S. Patent 2,639,851. 5 claims. May 26, 1953. Official Gaz. U. S. Pat. Office, **670**, 4: 1077. 1953.

A milk can lid having two tubular outlets, one for delivering milk into the can in such a manner that the milk flows down the inside of the can for rapid cooling, and the other to vent from the can the air displaced by the milk. R. Whitaker

586. Liquid weighing and dispensing vessel. H. A. Wons (assignor to Universal Milking Machine Div. of Nat'l Co-Operatives, Inc.). U. S. Patent 2,639,840. 1 claim. May 26, 1953. Official Gaz. U. S. Pat. Office, **670**, 4: 1074. 1953.

Structural details are given for a milk receiving vessel which is attached to a milking machine and to a scale. R. Whitaker

587. Animal actuated drinking fountain. A. F. Klinzing. U. S. Patent 2,639,690. 4 claims. May 26, 1953. Official Gaz. U. S. Pat. Office, **670**, 4: 1031. 1953.

A bowl shaped vessel which is supplied with water when the cow or other animal depresses a lever with its nose. R. Whitaker

ICE CREAM

588. Composition control of ice cream. J. A. Meiser, P. S. Lucas, and J. W. Kearney Jr., Mich. Agr. Expt. Sta., East Lansing. Ice Cream Rev., **36**, 11: 66, 67, 98-102. June, 1953.

Data are presented to show the effects of processing methods on the distribution of fat and total solids in ice cream. The data indicate that to maintain uniformity of composition in ice cream it is essential that: (1) composition of the mix ingredients be known, (2) mix be accurately calculated, (3) mix ingredients be weighed rather than measured, (4) composition of the mix be checked and adjusted if necessary prior to completing the pasteurization process, (5) mix vat be provided with adequate agitation, (6) mix be agitated for 30 min. following 12 hr. holding without agitation prior to freezing, (7) freezing operation to be carried out rapidly.

It is suggested that a skilled laboratory technician evaluate the processing operations from day to day, or that an experienced consultant be employed to evaluate the processing techniques and prescribe remedies as needed. W. J. Caulfield

589. Factors affecting quality in ice cream. Anonymous. Ice Cream Rev., **36**, 11: 126-127. June, 1953.

Research conducted at the Mich. Agr. Expt. Sta. on the effect of variations in processing procedure on the quality of ice cream is summarized as follows:

1. Pasteurization temperatures (150, 160, or 170° F.) showed no noticeable effect on ice cream quality.
2. An increase in homogenization pressure within the range of 1500-3500 lb. per sq. in. was accompanied by (a) a reduction in the size of the fat globules, (b) increased clumping of the fat globules, (c) more rapid melting, and (d) increased smoothness of the melted portion.
3. An increase in the temperature of homogenization within the range of 110-170° F. decreased viscosity and fat clumping in the mix. Homogenization temperature had little effect on acidity, pH, surface tension, protein stability, size of fat globule, score of the ice cream, melt-down characteristics, or ice crystal size.
4. Aging of the ice cream mix improved the quality of the ice cream and increased the whipping ability of the mix, and the melt-down was smoother and less watery than that frozen from unaged mixes.
5. Batch frozen samples hardened at 0, —10, and —20° F. averaged 27.7, 27.13 and 28.35 points on body and texture, respectively. Comparable samples frozen with the continuous freezer were scored 28.45, 28.65, and 28.9 points, respectively. The data indicate that hardening room temperatures have a significant effect on the body and texture score of ice cream.
6. The use of low hardening room temperature decreased the amount of melt-down in ice cream from both the batch and continuous freezers.
7. Ice crystals in the continuous-frozen ice cream were smaller than those in the batch-frozen ice cream. The smaller crystals afforded smoother texture and a slower rate of melting. W. J. Caulfield

590. Recent advances in the field of stabilizers and emulsifiers. S. J. Werbin, Stein, Hall & Co., New York City. Sou. Dairy Prod. J., **53**, 3: 38-40, 46-48. Mar., 1953.

Gelatin is a satisfactory stabilizer but requires aging of the mix. Sodium alginate is

easily incorporated into the mix, but (except at high temperatures) tends to precipitate calcium salts and cause thickening. Propylene glycol alginate is less likely to cause precipitation. Locust bean gum produces a chewy ice cream but tends to cause wheying off. Separation may be prevented by the addition of a secondary colloid.

Sodium carboxymethylcellulose improves whipping quality and is water soluble but tends to cause the mix to separate. Irish moss, or its extract, causes excessive viscosity but is a good secondary colloid to prevent separation. Guar seed gum has the advantage of being suitable for mixes to be pasteurized by the HTST method.

Emulsifiers are used to obtain drier ice cream. Egg yolk is a good food and emulsifier but is not as efficient as synthetic emulsifiers. The latter are glyceryl or sorbitan compounds of fatty acids or polyoxethylene derivatives of fatty acids or of their glyceryl or sorbitan compounds. The stearates are preferred. The "poly" type is twice as effective as the other synthetics but has not been approved by F.D.A. Emulsifiers facilitate over-run, decrease whipping time, and help in lubrication of the freezer. Lecithin is an unsatisfactory emulsifier. Emulsifiers may encourage shrinkage. The "poly" type has induced churning of the mix.

The addition of calcium sulfate in the range of 0.08% to 0.12%, a patented process, will stiffen ice cream and slow melt-down but encourages curdy melt-down. Similar amounts of sodium citrate or disodium phosphate have an opposite effect. These salts should not be added without ascertaining approval by the state. F. W. Bennett

591. Merchandising ice cream on retail milk routes. Anonymous. Sou. Dairy Prod. J., **53**, 3: 98, 99, 102. Mar., 1953.

A dairy with 100 retail milk routes has found the use of cartridges with eutectic points —8 and —12° F. satisfactory for holding ice cream on trucks during retail delivery. The cartridges were rehardened at —25° F. This method of distribution is profitable for several milk distributors in the Southwest. Increased total sales of ice cream are attributed to its use. F. W. Bennett

592. How to sell more ice cream at the fountain. W. J. Edwards, Beatrice Foods Co., St. Joseph, Mo. Sou. Dairy Prod. J., **53**, 5: 58-60, 64. May, 1953.

The 1951 dealer survey by the Intern. Assoc. of Ice Cream Mfrs. revealed that 27.9% of the ice cream gallonage was sold through grocery stores and 18.9% through drug stores. The average annual sales per outlet were 1,773 gal. in drug stores and 626 gal. in grocery stores. The sale of dipped ice cream, the sale of a wide variety of well advertised factory filled packages and novelties, and the employment of well trained personnel were proposed as means of increasing sales. Encouragement of the owners in keeping cost and inventory records will convince them of the profits being made, increase profits, and make enthusiastic dealers. It is advisable to furnish them with literature published by the Ice Cream Merchandising Institute. F. W. Bennett

593. A bacteriological and chemical study of ice milk. R. W. Ripper, V. D. Foltz, and W. H. Martin. Kan. Agr. Expt. Sta., Manhattan. J. Milk Food Technol., **16**, 3: 121-124. May-June, 1953.

The sanitary quality of 54 samples of ice milk sold in 18 Kan. towns exceeded the state and local regulations on frozen dairy products as shown by low bacterial counts, low acidity, and freedom from extraneous matter. The negative phosphate tests indicated efficient pasteurization.

Ice milk contains large amount of milk solids and lower overrun make this product comparable to ice cream in calorie value. H. H. Weiser

594. Soft ice milk. W. H. Martin, Kan. State Coll., Manhattan. Milk Plant Monthly, **42**, 5: 13, 14. May, 1953.

Over 100 million gal. of low fat frozen desserts were sold last year. In 1951, the figure was 45 million gal. This increase is attributed to consumers placing greater emphasis on milk solids, the growing popularity of low fat diets to reduce weight, and the lower price. The composition of the low fat products varies greatly. The fat content may vary from 2 to 6%, solids-not-fat from 11 to 15%, sweeteners from 12 to 19%, and the stabilizer-emulsifier combination from 0.4 to 0.5% or higher. Plain condensed skimmilk and nonfat dry milk solids are satisfactory sources of nonfat solids. Sugar or a combination of sugar and corn sirup solids may be used as sweetening agents. The mix may be pasteurized by heating to 160-165° F. and holding for 30 min. or by heating to 175° F. and holding for 25 sec. It is cooled to 140-145° F. and homogenized at a pressure of 3,000 to 3,500 lb. for single stage homogenization and 3,500 lb. on the first stage and 500 on the second when a 2-stage homogenizer is used. C. J. Babcock

595. Protein concentrates in soft ice milk. B. R. Weinstein and E. C. Scott, Crest Foods Co., Ashton, Ill. Milk Plant Monthly, **42**, 5: 15, 16, 64-66. May, 1953.

Milk proteins generally are recognized as the perfect protein food. Recently there has been developed a special soluble concentrated whole milk protein fusion product consisting of casein, lactalbumin and beta lactoglobulin in approximately the same proportions as they are found in milk. It is prepared from separated whole milk and solubilized for use in the dairy, pharmaceutical, and food industries. It is finding its greatest application in the dairy industry in the

manufacture of frozen desserts. Protein fortification of dairy products is proving to be a new selling point for the dairy industry. With approximately 34 million overweight persons in the U. S. the dairy industry can save and profit by the manufacture of high quality, protein-fortified, low-calorie dairy products.
C. J. Babcock

596. Ice cream scoop. L. R. J. McCoy, Jr. U. S. Patent 2,638,857. 4 claims. May 19, 1953. Official Gaz. U. S. Pat. Office, **670**, 3: 731. 1953.

An ice cream scoop having a jacketed receptacle and hollow handle containing a low freezing point medium. A lever, operated by the thumb, actuates a bar which discharges the portion of ice cream from the receptacle into which the product is pressed. R. Whitaker

597. Support for ice cream containers and the like. W. A. Daniels. U. S. Patent 2,639,039. 2 claims. May 19, 1953. Official Gaz. U. S. Pat. Office, **670**, 3: 782. 1953.

A metal frame consisting of two uprights, a handle, and two shelves for holding two 10-qt. cans of ice cream in the sleeve of an ice cream cabinet. Lugs are provided on the top shelf to prevent the can from turning. The bottom shelf is so shaped that the frame cannot rotate in the sleeve. R. Whitaker

598. Process for the manufacture of frozen comestibles. C. W. Decker. U. S. Patent 2,641,546. 8 claims. June 9, 1953. Official Gaz. U. S. Pat. Office, **671**, 2: 534. 1953.

Ice cream or ice cream mix is seeded with lactose of small particle size just prior to freezing to prevent sandiness or lactose crystallization in the hardened and stored product.
R. Whitaker

MILK AND CREAM

599. Milk automat. M. Michael, Staff editor, Milk Plant Monthly. Milk Plant Monthly, **42**, 5: 33, 34, 68, 69, 79. May, 1953.

Daily milk sales exceeding 13,500 qt. at a total delivery cost of 0.156¢ per qt. is the performance of 30 milk automats operated by Land O'Lakes Creameries, Inc. Twenty automats are in the metropolitan Twin City area, and ten are located in smaller cities in southern Minnesota. Primary requirements for an automat location are traffic and nearby population, ample parking space, and availability of personnel to make change and keep the vending units stocked with milk at all times. Both single and double model vendors are being used. The single unit vends 102 half gal. and handles a total storage of 800 half gal. The double unit vends 204 half gal. and will handle a total storage of 1,000 half gal. The same units will handle a total of 1,000 and 2,000 qt. respectively, but the Land O'Lakes operation is confined entirely to the half gal. packages. The cost summary analysis of 6 automats for July 1952 is given.
C. J. Babcock

600. Precautions in bulk handling. P. Corash, Bur. Food and Drugs, New York City Health Dept. Milk Plant Monthly, **42**, 5: 19, 20, 79. May, 1953.

Tank handling of producers milk has a definite place in our milk industry. It is not a panacea for all the difficulties of milk handling nor is it free of problems. It would be a serious mistake to distort the purpose of farm tanks by trying to fit them into a job for which they are not intended or to use them as a cover-up for poor quality milk. It would be unfortunate for producers and for the industry if overzealousness and misguided application brought the cold wall tank into such disrepute as to arouse strong opposition even to its most advantageous use. C. J. Babcock

601. A study of the supply and utilization of milk in Miss. E. E. Kern, Jr. Miss. Agr. Expt. Sta., State College. Tech. Bull. 35. Feb., 1953.

This bulletin is a report of a study of dairying in Miss. Production, wholesale purchase, utilization, sales of milk within the state, manufacturing plants, and types of by-products produced are discussed. Tables and graphs are presented. R. W. Hunt

MILK SECRETION

602. Microsomal particles of normal cows milk. R. K. Morton. Nature, **171**, 4356: 734. 1953.

After removing by centrifugal force such easily sedimentable materials from milk as blood cells, leucocytes, bacteria, and fat globules, high speed centrifugation (14,000 g. 45 min.) yields particles of casein-Ca phosphate complex (C). A lipoprotein fraction (L) was prepared by centrifuging buttermilk from washed cream at 14,000 g. for 45 min. Comparison of the C and L fractions showed the former to be practically free from enzymes and lipid material, whereas the latter exhibited such enzymes as alkaline phosphatase, diaphorase, and xanthine oxidase, as well as a high lipid content. Because the chemical and enzymatic characteristics of L are similar to the microsomal particles of animal tissues, it is suggested that the L particles in milk be called milk microsomes (M) and that they are released into the milk by the mammary gland. Apparently M are not derived from mitochrondria, as they show no succinic dehydrogenase or cytochrome oxidase. Electron micrographs show both C and M to be spheroidal in shape and varying in size from 250 μ to below 30 μ. C particles tend to clump, whereas M do not clump. M are less dense and usually appear flatter in shape than C. Since animals with mammary carcinoma secrete milk with more than the usual No. of M, the authors speculate on the possibility that M may carry the infective agent inducing carcinoma. R. Whitaker

NUTRITIVE VALUE OF DAIRY PRODUCTS

603. Nutrition is your business. C. C. KING, Nutrition Found., New York. Sou. Dairy Prod. J., **53**, 5: 82, 83, 86, 88, 96. May, 1953.

The advances in the science of nutrition are important to the dairy industry. The source of excessive deposits of cholesterol in the body which may lead to arteriosclerosis has been found to be excessive calories rather than cholesterol from such foods as milk, eggs, and meats. Fats normally do not interfere with calcium metabolism essential to optimum health. A generous level of animal protein is regarded as one of the most reliable characteristics of good diets. Good nutrition for the middle years of life is considered to be as important as for adolescent or the most advanced years. Physical deformities often have been traced to poor nutrition of the mother. Vitamin B_{12} found in milk is an important human nutrient. Deficiencies of choline during the growth period have appeared for a time to cause no harm, but have resulted in high blood pressure, hardening of the arteries and heart disease in the adult years.

F. W. Bennett

604. Dairy foods in reducing diets. N. D. KELLEY, Nat'l Dairy Council, Sou. Dairy Prod. J., **53**, 5: 66, 68, 70. May, 1953.

The public is becoming increasingly conscious of the dangers of overweight. The only safe road to normal weight is to eat the essential foods in correct amounts. In a research project at Mich. State Coll., two groups composed of a total of 21 overweight men and women safely lost on the average of 1½ and 2 lb., respectively, per person per wk. for about 17 wk. on diets containing dairy foods in adequate amount. The results have been dramatized in a color sound film by the Nat'l Dairy Council. Displays and booklets on the weight reduction research study also are available.

F. W. Bennett

605. Effect of varieties of acid-regenerated milk on the secretory, motor, and absorptive functions of the small intestine. S. A. GIL, Khorkov Maternity and Pediat. Inst. Voprosy Pediat. Ohrany Materinstva i Detstva, **20**, 6: 32-38. 1952. (Chem. Abstr., **47**: 5514h. 1953.)

S. Patton

606. The nutritive value of milk products. I. Fresh milk. LUCIE RANDOIN and JEAN CAUSERET, Inst. natl. recherche aliment, Paris. Bull. soc. sci. hyg. aliment, **40**: 223-255. 1952. (Chem. Abstr., **47**: 5572b. 1953.) S. Patton

607. The influence of dietary casein level on tumor induction with 2-acetylaminofluorene. R. W. ENGEL and D. H. COPELAND, Alabama Polytech. Inst., Auburn. Cancer Research, **12**: 905-908. 1952. (Chem. Abstr., **47**: 4975c. 1953.) S. Patton

608. Some aspects of lactose metabolism. WILLIAM J. RUTTER. Univ. Microfilms, Ann Arbor, Mich., Pub. No. 4473, 113 pp. Dissertation Abstr., **13**: 21. 1953. (Chem. Abstr., **47**: 4403b. 1953.) S. Patton

609. Protective factors of casein. (CCl₄ poisoning in rats). P. SFORZINI. Biol. Latina, **2**: 267-271. 1949. (Chem. Abstr., **47**: 4441h. 1953.) S. Patton

PHYSIOLOGY AND ENDOCRINOLOGY

610. Toxaphene; Transmission studies of milk of dairy cows fed toxaphene-treated hay. G. Q. BATEMAN, C. BIDDULPH, J. R. HARRIS, D. A. GREENWOOD, and L. E. HARRIS. Agr. and Food Chem., **1**, 4: 322-324. 1953.

Toxaphene has been recommended by federal and state agencies for control of insects which damage alfalfa. Differences in climate, insects, and farm practices necessitate testing the toxicity of insecticides in various parts of the country. The results indicate that alfalfa treated with 2 and 4 lb. of toxaphene per acre showed good economic control of insects which damage alfalfa under Utah (or arid) conditions. Feeding toxaphene-treated hay to dairy cows for 112 d. did not influence hay or grain consumption or milk and butterfat production and did not damage the liver and kidney tissues of the animals. Toxaphene was not found in the milk of cows receiving untreated hay but was found in the milk of cows receiving treated hays. The amounts were 2.5 and 2.3, 4.3 and 3.9, and 18.2 and 8.3 p.p.m. for the 1-, 2-, and 4-lb. per acre treatments, respectively.

S. Patton

611. Acute and prolonged insulin hypoglycemia in cows. D. E. JASPER, Univ. Calif., Davis. Am. J. Vet. Research, **14**, 51: 184-191. Apr., 1953.

Studies of the response of 4 cows to single and multiple injections of insulin in varying amounts are reported. Single intravenous doses of 1 mg. insulin per kg. body weight produced hypoglycemia for 2 hr. Doses of 2, 5, and 10 mg. per kg. caused deeper and more prolonged hypoglycemia, lasting 4-5, 7-8, and 12 hr., respectively. Signs produced by single injections were dullness, feed refusal, slight muscle tremor, and lack of bowel movements. When the hypoglycemia was prolonged by repeated injections of insulin, definite symptoms appeared at about 20 hr. These included depression, lethargy, hyperesthesia, hypersalivation, and some anorexia. After 10 to 25 hr. awkward gait, staggering, and continuous chewing and sucking movements were noted. This progressed to marked incoordination and inability to stand with behavior suggestive of near coma or near convulsions. After receiving glucose, the cows returned to normal in 18 to 36 hr. One not

given glucose returned to normal in 40 hr. after the last protamine insulin injection. Cows were able to withstand short periods of extreme hypoglycemia more readily than prolonged periods of hypoglycemia at relatively higher blood glucose levels. The responses were similar to those previously reported for hypoglycemic sheep. E. W. Swanson

612. Extraction, separation, and purification of 17-ketosteroids and of estrogenic phenol steroids from the urine of equine animals and cows. GIORGIO ROSENKRANTZ, Univ. Turin, Italy. Minerva ginecol., **4**: 231-235. 1952. (Chem. Abstr., **47**: 5478i. 1953.) S. Patton

613. Factors affecting the utilization of food by dairy cows. V. The digestibility and rate of passage of foods during L-thyroxine administration. C. C. BALCH, D. A. BALCH, S. BARTLETT, V. W. JOHNSON, and S. J. ROWLAND, Univ. Reading, Eng. Brit. J. Nutrition, **6**: 356-365. 1952. (Chem. Abstr., **47**: 5500i. 1953.) S. Patton

614. Phosphokinase and phosphatase activity of mammary gland homogenates. ELLIOTT M. CRAINE, Univ. of Ill., Urbana. Univ. Microfilms (Ann Arbor, Mich.), Pub. No. 4425, 92 pp. Dissertation Abstr., **13**: 110. 1953. (Chem. Abstr., **47**: 5525i. 1953.) S. Patton

615. Blood and milk levels produced by a sulfone and various sulfonamides in domestic animals. J. FRANCIS. J. Comp. Pathol. Therap., **59**: 245-264. 1949. (Chem. Abstr., **47**: 5541e. 1953.) S. Patton

616. The cholinesterase activity of the serum of newborn animals and of colostrum. R. A. MCCANCE, A. O. HUTCHINSON, R. F. A. DEAN, and P. E. H. JONES. Intern. Congr. Biochem., Abstr. of Communs. 1st Congr., Cambridge, Eng. 1949. (Chem. Abstr., **47**: 4390f. 1953.) S. Patton

617. The relation between phosphorus nutrition and the fertility of cattle. J. CHABANNES and S. MÉTIVIER. Phosphorsäure, **12**: 331-340. 1952. (Chem. Abstr., **47**: 4444g. 1953.) S. Patton

618. The intermediary metabolism of lactating mammary gland slices. S. J. FOLLEY and T. H. FRENCH. Intern. Congr. Biochem., Abstr. of Communs. 1st Congr., Cambridge, Eng. 1949. (Chem. Abstr., **47**: 4455i. 1953.) S. Patton

619. The biochemistry of phosphorus compounds of milk. VI. Electrophoresis of blood proteins of the lactating rabbit. EUGÈNE ROBILLARD, HENRI SIMONNET, and JOSEPH STERNBERG. Compt. rend., **235**: 1557-1559. 1952. (Chem. Abstr., **47**: 4989d. 1953.) S. Patton

620. Correlation between serum protein-bound iodine levels and metabolic rates in male bovine. K. H. BURNS, R. W. COLBY, PRISCILLA GOUGLER, and H. O. KUNKEL, Texas A. & M. Coll., College Station. Am. J. Physiol., **172**, 107-108. 1953. (Chem. Abstr., **47**: 4993h. 1953.) S. Patton

621. Hormone control of ovulation in the calf. WM. G. R. MARDEN, Univ. Cambridge, Eng. Endocrinology, **50**: 456-461. 1952. (Chem. Abstr., **47**: 4998d. 1953.) S. Patton

SANITATION AND CLEANSING

622. Cleaning stainless lines in place. R. F. HOLLAND, J. D. SHAUL, D. A. THEOKAS, and H. M. WINDLAN, Cornell Univ., Ithaca, N. Y. Food Eng., **25**, 5: 75-78. May, 1953.

Investigations were made on in-place cleaning of milk lines and an HTST pasteurizer using various cleaners and procedures. The hardness of the water supply was from 5 to 7 gr. Compounds containing considerable amounts of wetting agents gave a gelatinous film in the pipes. Acid and alkaline cleaner-sanitizers also gave a film deposit. In cold milk lines alkaline cleaners with added chlorine generally gave best results. In hot and cold pasteurized milk lines and the HTST unit, acid cleaning followed by alkaline cleaning plus chlorine was the most effective. Generally there was no correlation between film deposition and bacterial counts. The flow velocity of the cleaning solutions should not be less than 2½ ft./sec. T. J. Claydon

623. Bacteria thrive in rubber parts of milking machines. J. F. CONE, Pa. Agr. Expt. Sta., State College. 65th Ann. Rpt., p. 10. July, 1952.

Rubber inflations and tubes of milking machines are the greatest source of thermodurie bacteria. Leakage from the stanchion hose into the milker pail is possible, but in only 11 of 99 trials, under farm conditions, were bacteria counts in the milk increased by more than 2,000/ml. from this source. R. W. Hunt

624. Determination of lactose in dairy wastes. E. HINDIN. Sewage and Ind. Wastes, **25**: 188-190. 1953. (Chem. Abstr., **47**: 5036e. 1953.) S. Patton

625. Biochemical oxidation of dairy wastes. V. A review. SAM R. HOOVER. Sewage and Ind. Wastes, **25**: 201-209. 1953. (Chem. Abstr., **47**: 5036f. 1953.) S. Patton

626. Treatment and disposal of milk wastes. S. I. ZACK. Sewage and Ind. Wastes, **25**: 177-187. 1953. (Chem. Abstr., **47**: 5036f. 1953.) S. Patton

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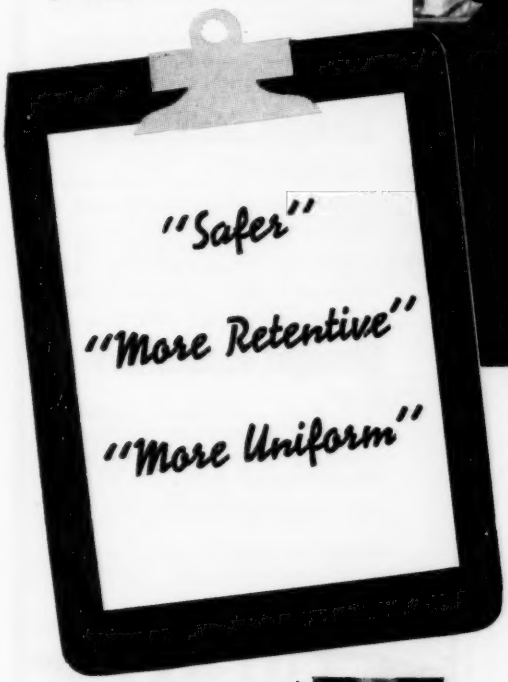

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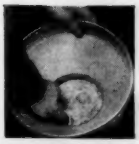
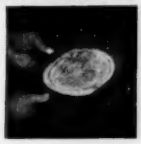


2. When filter disk is dry, it should be examined closely. The producer can identify the sediment or extraneous matter to determine its origin, and take precautions to prevent its reoccurrence.



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